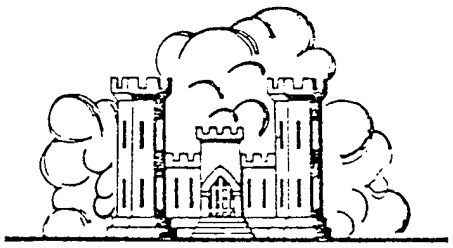
ENERGY ENGINEERING ANALYSIS PROGRAM (EEAP)

BURTONWOOD MILITARY COMMUNITY
UNITED KINGDOM

REVISED ENERGY REPORT
EXECUTIVE SUMMARY

DECEMBER, 1983



PREPARED FOR
DEPARTMENT OF THE ARMY
EUROPEAN DIVISION, CORPS OF ENGINEERS
CONTRACT NO. DACA 90-81-C-0096

A & E INTERNATIONAL / NEWCOMB & BOYD, CONSULTING ENGINEERS
A JOINT VENTURE
ATLANTA, GEORGIA

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EEAP - BURTONWOOD

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1.0 INTRODUCTION AND SUMMARY

1.1 Introduction

This document is the Executive Summary of the Energy Report of the Energy Engineering Analysis Program (EEAP) for the Burtonwood, England Military Community. The purpose of this document is to present analysis of potential energy conservation projects at each of the sites. The EEAP provides engineering studies of Army facilities to identify and analyze facility energy conservation projects. This program has been completed, is being performed, or is planned for all Army facilities worldwide. This project provides for completion of that program for Burtonwood Military Community with installations located in Burtonwood, Caerwent and Hythe, United Kingdom. Work is being performed under the direction of the European Division of the U.S. Army Corp of Engineers under Contract No. DACA90-81-C-0096. The study is being performed by A & E International/Newcomb & Boyd, Consulting Engineers, a joint venture, with home offices located in Atlanta, Georgia. Local engineering support for the project is being provided by Sulzer Brothers International. This report was originally submitted in December 1982. The revisions for this December 1983 revision primarily reflect modified ECIP guidance changes issued in February 1983. Other changes include the use of updated utility costs, FY83 utility consumption data, and changes related to the addition of Increment F work to the project scope.

1.2 Community Overview

A description and complete field survey data documenting the Community facilities in detail is included in the Data Report. For those readers without a copy of that document or who only wish an overview of the community, the

description is repeated below. The Burtonwood Military Community consists of three separate installations which are described in their "Facilities Energy Plans" as follows:

1.2.1 Burtonwood Army Depot

"Burtonwood Army Depot receives, inspects, classifies, stores, maintains, issues and rotates stocks DA materials and equipment. The installation also includes Family Housing, BOQ, Troop and Transit Housing.

The total land area available for use by the US Forces is approximately 672 acres including grassed areas and a helipad. 641 acres is utilized for administrative, housing, storage, maintenance and other supporting purposes. The land area is in two sections known as Site 3 and Site 8. The former is the housing area of 22 acres comprising 109 dwelling units in Duplex single storey form plus recreational buildings. The latter are World War II SECO buildings in an advanced state of disrepair.

In 1958 the US Air Force began phasing down the operation at Burtonwood, although it was not closed until 1965 when control was once again passed to the Royal Air Force to remain in an inactive status. Many of the structures were found to have exceeded their normal life expectancy and/or usefulness and a great majority of the buildings were demolished in the interest of economy. The warehouse areas, however, were retained on Site 8. Other storage areas in the form of hangars were retained on other sites also. Upon the withdrawal of the US Forces from France in 1966 and 1967, it became necessary to seek new storage sites in the Communication Zone of Europe. The US Army

selected RAF Burtonwood as the primary site for storing theater reserve stocks and supplies."

1.2.2 Caerwent Army Depot

"Caerwent Ammunition Depot is a disused UK naval propellant factory built in 1938-39. It is made available to the US Army free of charge. The buildings were not provided with any form of thermal insulation. The original heating system was by steam from two large boiler houses which supplied heat needed for industrial purposes in addition to space heating. On conversion to an ammunition depot this heating was demolished. Because the comparatively few buildings requiring heat were spread over 1000 acres, individual plants were installed for each location.

None of the buildings used for the storage of ammunition, inert materials or general stores have any form of heating, internal lighting or power."

1.2.3 United States Army Marine Fleet Activity (Hythe)

"United States Army Marine Facility at Hythe is owned by the United Kingdom Ministry of Defense (MOD) and was rented by White's Shipyard until 1967. It was handed over to USAMFA as a Contracted Operation (GOCO) in that year. In 1974 the workforce became Direct Hired personnel of the United States Army and the operation a Government Owned Government Operated (GOGO equiv.).

There are 36 buildings comprising offices, storage buildings, an extensive jetty, dolphins and large workshops and a large hangar previously used to house flying boats.

As mentioned in the preface, the facility has two slipways, the larger of the two leading into the hangar (Building #11) which is presently used to store up to 30 x 65 foot tugboats. A project has been submitted to HQs Burtonwood to raise the roof and permit greater utilization. The hangar has open sides and is unheated. The cocooned craft stored are all continuously hooked up to an electrical supply for operating de-humidifiers on each craft."

1.3 Scope

1.3.1 EEAP Scope

The objectives of the EEAP as stated in the project Schedule of Title 1 Services are:

"a. Develop a systematic plan of projects that will result in the reduction of energy consumption in compliance with the objectives set forth in the Army Facilities Energy Plan without decreasing the readiness posture of the Army.

b. Use and incorporate applicable data and results of related studies, past and current, as feasible.

c. Develop coordinated base wide energy systems plans for each military community.

d. Prepare Program Development Brochures (PDB's), DD Forms 1391 and supporting documentation for feasible energy conservation projects.

e. Include in the program studies all methods of energy conservation which are practical (in so far as the state-of-the-art is reasonably firm) and

economically feasible in accordance with guidance given.

f. List and prioritize all recommended energy conservation projects."

A complete copy of the Schedule of Services is included in the Data Report. EEAP project activity is divided into three increments:

1.3.1.1 Increment A

Energy conservation projects related to conservation in buildings which would be funded from the Energy Conservation Investment Program (ECIP) part of the military construction program.

1.3.1.2 Increment B

This includes energy conservation projects for utilities and energy distribution systems. It also includes computerized energy monitoring and control systems.

1.3.1.3 Increment G

This increment applies to energy conservation projects of a size or nature that would be funded from maintenance, repair (OMA) and minor construction project (MMCA) funds.

1.3.1.4 Increment F

This increment includes modifications and changes in system operations which are within the military community's funding authority and management control.

This increment was added to the EEAP project scope following completion of other increments/phases and is provided in a separate report.

1.3.2 EEAP Process

An EEAP project is performed in three phases as follows:

1.3.2.1 Phase I

The primary purpose of this phase is to gather energy related site data (written and verbal) and perform a field survey of the site to identify existing facility physical and operational conditions. The Preliminary Submittal occurs at the end of Phase I and documents the data gathered during Phase I. That submittal has been updated and forms the bulk of the Data Report.

1.3.2.2 Phase II

During this phase, the information obtained during Phase I is analyzed to identify energy conservation projects. Once those projects are identified, they are analyzed to project potential savings and cost which would occur if the projects were implemented. The savings and cost are analyzed using standardized economic procedures and then prioritized based that economic evaluation. The Interim Submittal is provided at the end of Phase II and documents the project selection and analysis process. The Interim Submittal consists of the Updated Data Report, this Energy Report and other miscellaneous documents.

1.3.2.3 Phase III

During this phase, funding documents (Forms 1391 and Program Development Brochures) are prepared for those projects identified in Phase II as having economic characteristics which satisfy the appropriate criteria (ECIP). At the completion of Phase III, the Pre-final Submittal is made and includes all proposed funding documents. Government comments on the Pre-final Submittal are then incorporated in a Final Submittal.

1.3.3 Project Scope

The work in this project includes both buildings and utility systems. Funding for the project is not sufficient to survey and analyze every single building in the Community, therefore, the major installations and largest and/or most typical buildings were selected for field survey and analysis. A prenegotiation visit to this site was made where representatives of the Community, European Division Corp of Engineers, and the A/E jointly selected buildings to be surveyed and analyzed. Those buildings designated during the prenegotiation site visit for field survey are listed in Figure 1.1, 1.2, and 1.3. In addition to buildings, utility systems at each site are included in the scope of the investigation. Utility systems included are boiler plants, electrical and thermal distribution, and exterior lighting.

1.4 Executive Summary Scope

This report provides a summary of the energy and cost analysis leading to recommendation of proposed energy conservation projects documented in the Energy Report. The Energy Report's prime objective is to use the data gathered

during site visits and field inspections to select, analyze savings, estimate cost and evaluate economic criteria for energy conservation opportunities. Section 2.0 of this report provides illustration of the existing energy situation at each site based on the available information provided by the Community. Energy conservation opportunities (ECOs) considered for selection, or reasons for their rejection are documented in Section 3.0 of the Energy Report. These ECO's are derived from the Army Facilities Energy Plan, community suggestions, and experience on other projects. Section 4.0 of the Energy Report provides a summary of calculated energy savings and capital investment cost for each of the ECO projects. Section 5.0 of the Energy Report summarizes economic analysis results performed using Energy Conservation Investment Program (ECIP). In Section 6.0 of the Energy Report, the selected ECO's are ranked based on S/I ratios and are then grouped to form proposed construction projects. Composite ECIP economic analysis for the proposed projects are also included in Section 3.0 of this report. Figures, tables, and graphs referenced in each section are included in Section 4.0. The detailed backup calculations for the ECO savings and cost analysis and the economic analysis are included in Appendices of the Energy Report.

Throughout this report, all data has been broken down by the three sites which make up the Burtonwood Community. Since the three sites are widely separated geographically, it is not generally practical to combine work at more than one site into a single construction project. Therefore, all savings and cost analysis has been separated on a site by site basis.

1.5 Phase II Methodology

1.5.1 Objectives: The primary end product of EEAP Phase II is a consolidated list of architectural, mechanical, and electrical modification projects which will result in a reduction of energy consumption. The list includes estimated construction cost and energy saved for each project along with appropriate economic indicators (S/I Ratio) as dictated by ECIP criteria. The list is arranged in order of best (largest) S/I Ratio. From this list, Community and Corps of Engineers personnel will coordinate selection of projects for preparation of funding documents (1391, PDBs) and the time frame for execution of those projects. Funding documents will be prepared for those selected projects as a part of Phase III of the EEAP program.

1.5.2 Methodology: The Phase II analysis is accomplished by following these basic steps:

Step 1 - Prepare a master list of energy conservation opportunities (ECO) for buildings and utility systems based on Phase I experience and the list of ECOs included in the Army Facilities Energy Plan.

Step 2 - For each building and utility system at each installation, select those ECOs from the master list which are applicable according to the Phase I survey data.

Step 3 - Calculate energy savings for each ECO/building/system combination. The calculation process uses a combination of computerized and manual methods. Manual

methods are used where the ECOs are simple and are not affected by other ECOs. Computer analysis is used for building ECOs where many interrelated factors affect the results. The computer analysis consists of a base-line and modified analysis. The base-line run is based on existing conditions and operations. Subsequent runs simulate performance after the energy conservation project under study is implemented. The difference between those runs are the savings estimated for that ECO.

Step 4 - Calculate the cost to implement each ECO selected for each building. General unit cost have been developed from manufacturer's quotes and contracting experience provided by Sulzer Brothers. Those unit costs are multiplied times the quantity of occurrences in a building or system to compute the total installation cost. All costs in the Phase II analysis are based on FY83 award After projects are selected and scheduled following Phase II, the cost will be escalated and updated to the time at which the project is finally scheduled.

Step 5 - Based on the savings and cost identified in Steps 3 and 4, economic analysis as defined in ECIP criteria is performed. Economic parameters include Total Discounted Savings, and S/I Ratio. These are summarized in a table and listed in order based on S/I Ratio.

Step 6 - A suggested packaging scheme for combining individual ECOs for individual buildings into projects is prepared. The packaging could be

based on installation (i.e. all work in the Hythe installation) or type (i.e. all roof insulation on pitched roofs), or, most likely, some combination of installation, type work, and energy savings (S/I Ratio).

1.6 Phase III Preparation

A previously stated, Phase III of the EEAP program consists of preparation of funding documents (Form 1391 and Project Development Brochures). These documents will be prepared based on the government comments returned on this report submittal. Prior to beginning work on Phase III, it is requested that the latest criteria for preparation of these programming documents be furnished. Criteria furnished at the beginning of this project may have changed and the latest version should be used to avoid unnecessary modifications and changes after the Phase III submittal.

2.0 EXISTING ENERGY SITUATION

2.1 Background

One of the requirements of the EEAP program is to examine the existing energy situation at each site where an EEAP study is performed. There are several reasons this effort is included. One of the prime motivations is the Army Facilities Energy Plan objective to reduce energy usage by 20% by the year FY85 in comparison to a base year of FY75. In an EEAP study, one of the objectives is to identify the base year (FY75) consumption and compare the current energy situation to that value. Based on this comparison, some judgement can be made as to additional effort required in terms of new construction projects to allow reductions to meet the goal.

In addition to comparison with the FY85 energy goal, examination of the existing energy situation can provide an indication of the relative importance of each type or component of energy consumption. By comparing how much energy is used for heating vs. the consumption for domestic water heating for example, the study may establish priorities for those items which have the greatest potential for energy savings. One difficulty which arises in performing this type of analysis is the general lack of sub-metering data of a particular installation's energy consumption. Since most Army facilities were constructed during a time when energy costs were relatively unimportant, very little emphasis in the past has been placed on actual metering of energy usage for a particular function. For example, it's impossible in most cases to examine actual metered data of individual building's energy consumption within a facility or the usage of energy for different activities within a building. Since this metered data is

not available, engineering estimates have to be made to determine the data.

A third objective in examining the existing energy situation at a facility is to provide an overview prior to the detailed point by point energy conservation opportunity evaluation. Because the detailed analysis is so voluminous, it's easy to lose track of the objective of the EEAP program.

2.2 General Description

The three Burtonwood Military Community sites (Burtonwood, Caerwent, and Hythe) utilize electricity purchased through the United Kingdom Department of the Environment (DOE). DOE bills the U.S. Army for its portion of consumption at each of the sites. At the Burtonwood Army Depot coal, natural gas, and fuel oil are used for heating and domestic water heating purposes. At Caerwent and Hythe, a combination of natural gas and oil is used for heating and domestic water loads.

The primary use of electricity at all three sites is for lighting (interior and exterior) and operation of heating distribution equipment. There is very little total electrical use for other purposes within the Community. Some equipment and appliance electrical loads are present but since all sites are primarily storage facilities, these loads are not significant. Some small portable electric heaters were noted in office locations, but there were few of these and no significant electric heating was noted.

Fuel consumption (coal, natural gas, and oil) is primarily used for space heating. There are no significant process loads. Domestic hot water heating is generally included in the fuel consumption, however that forms a minimal

percentage of the total consumption. There are no large food service, laundry, or living quarters facilities within the community relative to the total square footage in the community. This is due to the nature of the sites as storage facilities and the general use of local civilians for most positions with minimal U.S. military personnel at each of the sites.

2.3 Site Comparisons

Figure 2.1 illustrates the FY 83 electrical and fuel usage totals for the three sites within the Community. The relative quantities of each type energy consumption are included on this illustration. All electrical consumption has been converted to MBTUs (millions of BTU's) to allow comparison. It should be noted that the conversion of electrical usage has been based on a figure of 11,600 BTUs per kilowatt hour of electricity. This is the so called "source" energy conversion figure required in ECIP program analysis. Figure 2.1 indicates by far the greatest energy consumption element is coal consumption at the Burtonwood site. By examining this figure, the site and energy source which has the greatest usage and thus greatest potential savings is readily apparent. Figures 2.2, 2.3, and 2.4 illustrate consumption totals for the last four years, plus estimated FY75 base year, at the three sites. Data for FY75 was originally requested from the Community, however it is not available. As stated in the Community Facilities Energy Plan for FY82, the best approximation available for use as a base year is total energy usage for FY77. This data represents believable record data and is comparable in terms of facility usage. FY77 total energy consumption has been assumed to be the best estimate of FY75 base year consumption. It has been used as the basis for the estimated FY75 consumption. That data is only provided as

total energy use and is not available by fuel or on a monthly consumption basis.

2.4 Site Consumption Data

Figures 2.5, 2.6, and 2.7 illustrate electrical usage data for the three Community sites. Actual demand data for the Burtonwood site is not available since demand metering is done on an overall basis for combined DOE and U.S. Army facilities. Records of electrical service to the U.S. Army facilities at that site do not include demand data. Data for FY75 was originally requested from the community. However, it was not available. The last four years (FY80, FY81, FY82, and FY83) of data were provided and are illustrated on the figures. While the record keeping system now in use in the Community appears to be complete and be conscientiously updated, this has apparently not been true in earlier years. Data for the early 70's including FY75 is apparently in very poor condition. This may be due to the number of changes in status of the sites (from British Army or Navy facilities to RAF facilities to private industry to Department of Environment to US Army, etc), but has stabilized in 1970's and record keeping appears to be adequate at this time.

No clear trends are identifiable from the data provided for the past three fiscal years. There is a significant increase in the use of electrical energy during the winter. Since no large quantities of electric heat are utilized, this increase is primarily due to the operation of heating distribution equipment (conveyors, fans, pumps, etc.). In addition to heating distribution equipment, artificial lighting for interior and exterior service is used to a greater degree in the winter time due to the reduced daylight hours in these far northern latitudes.

Figures 2.8 to 2.10 indicate fuel consumption for the Burtonwood site over the past four fiscal years. As stated for the electrical data above, no reliable information has been provided for the FY75 base year. Again, no clear trends are apparent from the fuel consumption data. Summer consumption of natural gas and oil at Burtonwood is primarily due to domestic hot water heating usage within the few family housing units which are currently occupied.

Figures 2.11 and 2.12 illustrate natural gas and oil consumption at the Caerwent site while Figure 2.13 and 2.14 illustrate those same fuels at the Hythe installation. No clear trends are apparent from this data except that summer consumption at each site is primarily due to the minimal domestic hot water heating loads within the installations.

2.5 Energy Consumption Components

As discussed earlier, no detailed sub-metering data is available for the sites which would indicate component consumption of different energy types.

2.6 Energy Rates

In order to perform ECIP economic analysis, unit prices for each different type of fuel must be determined. Since all three sites procure their fuel separately, the cost for each site is different. Unit prices for each type of fuel which have been used in the ECIP economic analysis are listed in Figure 2.15. These figures were derived from data obtained at the Burtonwood headquarters in November, 1983.

2.7 Summary

Since FY75 energy consumption data has proved difficult to obtain, all analysis in this report will be compared against

estimated FY75 consumption data based on total records for FY77. As can be seen from the figures in this section, the bulk of the energy used for all three sites is for space heating. This is primarily due to the fact that all sites are primarily storage facilities with large floor areas relative to their occupancy densities. In addition, the bulk of the buildings exterior skins have not been significantly modified since their original construction. Thus, heating losses are very high. There are two ways to reduce the heating energy consumption. Those are to reduce the load and to improve the efficiency of the heating system. As will be seen in later sections of this report, most of the heating systems are in good condition and have been refurbished or modified within the past five years. Thus very little opportunity for energy conservation is available in that respect. However, building skins (and thus loads) have not been modified due to the very high capital costs involved in performing such improvements. This will be the primary area of potential energy savings illustrated in this report.

2.8 Utility Metering

2.8.1 Electricity

Changes in existing revenue metering at the Burtonwood site are not recommended. The entire site (Burtonwood Army Depot and Department of Environment, UK) has a consolidated revenue meter. Adequate submetering exists for separating Department of Environment, UK and Burtonwood Army Depot billing. Adequate submetering exists at Family Housing for billing.

A project to consider consolidation of site revenue metering and service is recommended for the Caerwent facilities. Four site revenue metering and service

points exist. The entire facility is metered and served by a 2000 KVA transformer located in Building 47, except for Bachelor Housing, Building 971 and Building 49. Existing revenue metering at Bachelor Housing, Building 971 and Building 49 could be retained as submetering for record and billing purposes.

Changes in existing revenue metering at the Hythe site are not recommended. The entire site has a consolidated revenue meter. There appears to be no apparent necessity for additional submetering.

2.8.2 Fuels

Records of monthly coal, gas and fuel oil usage are maintained currently on an adequate basis. Coal and oil usage are recorded for each boiler plant and since each plant basically serves one building, no additional submetering is required. Natural gas is currently metered at one point per site however gas usage is relatively low and additional metering by user is not economically justifiable. Gas is primarily used for heating of quarters (family housing and bachelor) at the Burtonwood site and installation of meters for each individual housing unit is not practical since current Army policy prohibits charging occupants with monthly utility costs.

3.0 PROPOSED PROJECTS

In order to determine which ECOs should be included in construction projects, several steps must occur. The first step is to eliminate any ECO which does not meet the minimum ECIP economic criteria. This basically consists of eliminating any ECO whose savings/investment ratio (SIR) is less than one (1.0). The second step in the project analysis process is to sort all remaining ECOs in order of priority based on SIR. In this ranking by priority, all architectural, mechanical, and electrical ECOs are combined in one table per site. The results of these steps are illustrated in Tables 3.1 through 3.3 for each site of the Burtonwood community. "ECO ITEM NO" in those tables is defined in Section 3.0 of the Energy Report and in subsequent tables in this report.

There are many different approaches to combining different ECO's into construction projects. One project per building is one approach. Another is to group ECOs with highest SIRs into projects without regard to which buildings or type of work are involved. The approach proposed here is to group ECOs by type of work primarily. The final grouping for preparation of funding documents has been determined by Community and COE comments. A total of 10 projects have been identified in Table 3.4 for the Burtonwood site. 9 projects at Caerwent and 7 at Hythe are listed in Tables 3.5 and 3.6. Note all monetary figures are in U.S. dollars. Note also some of the projects listed are alternate approaches to the same work and only one will be chosen for funding document preparation.

Using the data in Tables 3.4, 3.5 and 3.6, project ECIP calculations have been performed and the results along with brief descriptions of the projects are summarized below.

3.1 Burtonwood Projects

3.1.1 Burtonwood Project 1

Work includes spray-on type roof insulation for Building 1.

Construction Cost:	$3,171,954.
Elec Savings (KWH):	0.
Coal Savings (MBTU):	70,600.
Oil Savings (MBTU):	0.
Gas Savings (MBTU):	0.
Discounted Savings/Investment Ratio:	1.01.
Total Annual Energy Savings (MBTU):	70,600.

3.1.2 Burtonwood Project 2

Work includes weatherstripping of doors and installation of PVC thermal curtains at loading lock doors for Buildings 1, 10 and Building 2 Shipping and Receiving, and installation of 1 personnel vestibule in Building 1.

Construction Cost:	$ 72,741.
Elec Savings (KWH):	0.
Coal Savings (MBTU):	8,452.
Oil Savings (MBTU):	0.
Gas Savings (MBTU):	0.
Discounted Savings/Investment Ratio:	5.29.
Total Annual Energy Savings:	8,452.

3.1.3 Burtonwood Project 3

Work consists of all ECOs related to Building 244 and includes wall insulation and replacement of the existing electric heating system with a gas fired hot water heating system.

Construction Cost:	$38,589.
Elec Savings (KWH):	119,254.
Coal Savings (MBTU):	0.
Oil Savings (MBTU):	0.
Gas Savings (MBTU):	0.
Discounted Savings/Investment Ratio:	2.16.
Total Annual Energy Savings:	1,383.

3.1.4 Burtonwood Project 4

Work consists of all ECOs related to Building 4 and includes weatherstripping, vestibules, fireplace dampers, and pipe insulation. Note that recommendations for building consolidation or replacement in Section 3.4 would eliminate the need for this project if implemented.

Construction Cost:	$14,565.
Elec Savings (KWH):	0.
Coal Savings (MBTU):	0.
Oil Savings (MBTU):	1,903.
Gas Savings (MBTU):	0.
Discounted Savings/Investment Ratio:	9.7.
Total Annual Energy Savings:	1,903.

3.1.5 Burtonwood Project 5

Work consists of installation of a central supervisory control system serving Buildings 1, 2, and 10. If this system is implemented then projects 8, and 10 will not be required.

Construction Cost:	$282,828.
Elec Savings (KWH):	0.
Coal Savings (MBTU):	19,664.
Oil Savings (MBTU):	0.
Gas Savings (MBTU):	0.
Discounted Savings/Investment Ratio:	3.16.
Total Annual Energy Savings:	19,664.

3.1.6 Burtonwood Project 6

Work consists of miscellaneous mechanical modifications to heating systems. In Building 2, the domestic hot water storage tanks and some piping would be insulated. Work includes addition of winter mode ventilation cycling controls for ventilation units serving Building 2 Header House area and timeclock control of domestic hot water circulating pumps serving Building 2.

Construction Cost:	$ 6,740.
Elec Savings (KWH):	0.
Coal Savings (MBTU):	896.
Oil Savings (MBTU):	0.
Gas Savings (MBTU):	0.
Discounted Savings/Investment Ratio:	6.05.
Total Annual Energy Savings:	896.

3.1.7 Burtonwood Project 7

Work includes installation of cavity wall insulation in family housing units.

Construction Cost:	$16,696.
Elec Savings (KWH):	0.
Coal Savings (MBTU):	0.
Oil Savings (MBTU):	0.
Gas Savings (MBTU):	681.
Discounted Benefit/Cost Ratio:	2.29.
Total Annual Energy Savings:	681.

3.1.8 Burtonwood Project 8

Work consists of night setback control installation in Buildings 1 and 10 by overriding existing thermostat control of unit heaters. This is one alternate for work also included in projects 5 and 10.

Construction Cost:	$123,259.
Elec Savings (KWH):	0.
Coal Savings (MBTU):	11,861.
Oil Savings (MBTU):	0.
Gas Savings (MBTU):	0.
Discounted Savings/Investment Ratio:	4.38.
Total Annual Energy Savings:	11,861.

3.1.9 Burtonwood Project 9

Work includes miscellaneous lighting modifications in Buildings 1, 10 and the Shipping and Receiving Area of Building 2 and exterior lighting modifications for Site 3.

Construction Cost:	$74,008.
Elec Savings (KWH):	153,740.
Coal Savings (MBTU):	0.
Oil Savings (MBTU):	0.
Gas Savings (MBTU):	0.
Discounted Savings/Investment Ratio:	1.45.
Total Annual Energy Savings:	1,783.

3.1.10 Burtonwood Project 10

Work consists of night setback control installation in Buildings 1 and 10 by providing new zone control valves for each "warehouse". This is one alternate for work also included in projects 5 and 11.

Construction Cost:	$160,436.
Elec Savings (KWH):	0.
Coal Savings (MBTU):	12,744.
Oil Savings (MBTU):	0.
Gas Savings (MBTU):	0.
Discounted Savings/Investment Ratio:	3.62.
Total Annual Energy Savings:	12,744.

3.2 Caerwent Projects

Note that work is included in projects which is related to Building 305 which will not be necessary if modifications proposed in Section 3.4 are implemented.

3.2.1 Caerwent Project 1

Work consists of roof insulation of Building 936.

Construction Cost:	$ 3,531.
Elec Savings (KWH):	0.
Coal Savings (MBTU):	0.
Oil Savings (MBTU):	76.
Gas Savings (MBTU):	0.
Discounted Savings/Investment Ratio:	1.60.
Total Annual Energy Savings:	76.

3.2.2 Caerwent Project 2

Work includes wall insulation work in Buildings 6, 11, 82, 88, 304, 582, 936, and 971, and installation of opaque wall panels in place of unused windows in Buildings 6 and 11.

Construction Cost:	$24,152.
Elec Savings (KWH):	0.
Coal Savings (MBTU):	0.
Oil Savings (MBTU):	1,756.
Gas Savings (MBTU):	427.
Discounted Savings/Investment Ratio:	6.51.
Total Annual Energy Savings:	2,183.

3.2.3 Caerwent Project 3

Work consists of replacing single glazing with standard double glazing units in Buildings 88, and 936. This is an alternate approach to the same work as Project 4.

Construction Cost:	$22,326.
Elec Savings (KWH):	0.
Coal Savings (MBTU):	0.
Oil Savings (MBTU):	142.
Gas Savings (MBTU):	364.
Discounted Savings/Investment Ratio:	1.49.
Total Annual Energy Savings:	506.

3.2.4 Caerwent Project 4

Work consists of replacing single glazing with special "K" type double glazing units having an improved U-factor over standard double glazing. Work is included in Buildings 6, 88, and 936. This is an alternate approach to the same work in Project 3.

Construction Cost:	$47,153.
Elec Savings (KWH):	0.
Coal Savings (MBTU):	0.
Oil Savings (MBTU):	532.
Gas Savings (MBTU):	551.
Discounted Savings/Investment Ratio:	1.57.
Total Annual Energy Savings:	1,083.

3.2.5 Caerwent Project 5

Work consists of replacement of loading dock doors at Building 6.

Construction Cost:	$14,700.
Elec Savings (KWH):	0.
Coal Savings (MBTU):	0.
Oil Savings (MBTU):	205.
Gas Savings (MBTU):	0.
Discounted Savings/Investment Ratio:	1.04.
Total Annual Energy Savings:	205.

3.2.6 Caerwent Project 6

Work consists of installation of thermostatic radiator valves in Building 82.

Construction Cost:	$7,607.
Elec Savings (KWH):	0.
Coal Savings (MBTU):	0.
Oil Savings (MBTU):	262.
Gas Savings (MBTU):	0.
Discounted Savings/Investment Ratio:	2.56.
Total Annual Energy Savings:	262.

3.2.7 Caerwent Project 7

Work consists of ductwork and control modifications to heating and ventilating units in Building 6 to reduce heating of outside air.

Construction Cost:	$3,793.
Elec Savings (KWH):	0.
Coal Savings (MBTU):	0.
Oil Savings (MBTU):	695.
Gas Savings (MBTU):	0.
Discounted Savings/Investment Ratio:	13.61.
Total Annual Energy Savings:	695.

3.2.8 Caerwent Project 8

Work consists of addition of vestibule at entrances to Buildings 6, 11, 82, 88 and 582.

Construction Cost:	$11,613.
Elec Savings (KWH):	0.
Coal Savings (MBTU):	0.
Oil Savings (MBTU):	1,155.
Gas Savings (MBTU):	0.
Discounted Savings/Investment Ratio:	7.39.
Total Annual Energy Savings:	1,155.

3.2.9 Caerwent Project 9

Work consists of weatherstripping, wall insulation, and new double glazing (K units) of Building 305.

Construction Cost:	$15,286.
Elec Savings (KWH):	91,706.
Coal Savings (MBTU):	0.
Oil Savings (MBTU):	0.
Gas Savings (MBTU):	0.
Discounted Savings/Investment Ratio:	4.20.
Total Annual Energy Savings:	1,064.

3.3 Hythe Projects

Note that work listed in Buildings 2, 3, 4, 5, 6, 30, 31, 32, 33 and 34 will not be necessary if consolidations proposed in Section 3.4 are implemented.

3.3.1 Hythe Project 1

Work includes wall insulation for Buildings 2, 5, 6, and shop area of 29, installation of opaque wall panels in place of unused windows in Buildings 13, 14, 30 and 33, and blocking up an unused vehicle door in Building 14.

Construction Cost:	$43,801.
Elec Savings (KWH):	0.
Coal Savings (MBTU):	0.
Oil Savings (MBTU):	1,440.
Gas Savings (MBTU):	79.
Discounted Savings/Investment Ratio:	2.55.
Total Annual Energy Savings:	1,519.

3.3.2 Hythe Project 2

Work includes roof insulation work in Buildings 1 and 29.

Construction Cost:	$30,324.
Elec Savings (KWH):	0.
Coal Savings (MBTU):	0.
Oil Savings (MBTU):	546.
Gas Savings (MBTU):	0.
Discounted Savings/Investment Ratio:	1.34.
Total Annual Energy Savings:	546.

3.3.3 Hythe Project 3

Work consists of miscellaneous outdoor lighting modifications for the site as a whole.

Construction Cost:	$11,448.
Elec Savings (KWH):	90,885.
Coal Savings (MBTU):	0.
Oil Savings (MBTU):	0.
Gas Savings (MBTU):	0.
Discounted Savings/Investment Ratio:	5.56.
Total Annual Energy Savings:	1,054.

3.3.4 Hythe Project 4

Work consists of adding individual heating zone controls and timers for Buildings 30, 31, 32, 33 and 34.

Construction Cost:	$3,505.
Elec Savings (KWH):	0.
Coal Savings (MBTU):	0.
Oil Savings (MBTU):	0.
Gas Savings (MBTU):	145.
Discounted Savings/Investment Ratio:	2.59.
Total Annual Energy Savings:	145.

3.3.5 Hythe Project 5

Work consists of replacing single glazing with standard double glazed units. Project is an alternate approach to the same work included in Project 6 and includes Building 1 only.

Construction Cost:	$ 3,572.
Elec Savings (KWH):	0.
Coal Savings (MBTU):	0.
Oil Savings (MBTU):	36.
Gas Savings (MBTU):	0.
Discounted Savings/Investment Ratio:	1.31.
Total Annual Energy Savings:	63.

3.3.6 Hythe Project 6

Work consists of replacing single glazing with special double glazed "K" units with better U-factor than standard double glazing. Project is an alternate approach to the same work included in Project 5 and includes Building 1 only.

Construction Cost:	$ 4,197.
Elec Savings (KWH):	0.
Coal Savings (MBTU):	0.
Oil Savings (MBTU):	96.
Gas Savings (MBTU):	0.
Discounted Savings/Investment Ratio:	1.70.
Total Annual Energy Savings:	96.

3.3.7 Hythe Project 7

Work includes installation of vestibules in Buildings 5, 6, 15, 30 and 31.

Construction Cost:	$10,859.
Elec Savings (KWH):	0.
Coal Savings (MBTU):	0.
Oil Savings (MBTU):	256.
Gas Savings (MBTU):	128.
Discounted Savings/Investment Ratio:	2.49.
Total Annual Energy Savings:	384.

3.4 Building Consolidation or Replacement Projects

While performing the field survey and subsequent analysis, some cases were noted where buildings were in such condition or configuration that it is questionable whether spending funds to improve their energy consumption would be advisable. In these cases, major modifications or entire building replacement would seem to be justified based on the condition of the structures. Although a complete functional and life cycle analysis of these structures is beyond the scope of an EEAP study, some preliminary cost and savings figures have been prepared in APPENDIX A of the Energy Report. No ECIP analysis has been performed on these replacement projects since the replacement cannot be justified on energy savings only, however if the energy savings are considered with the life cycle cost of maintaining these structures over the next 25 years, they should be justified.

3.4.1 Burtonwood Building 4

This structure is a rambling conglomeration of prefab elements which have basically been used beyond their useful life. See the DATA REPORT for photographs which indicate

the condition of the building. In APPENDIX A of the Energy Report, two ECOs were identified for this building. One, M-27, calls for total replacement, while an alternate, M-25, calls for "infilling" some of the spaces between wings to reduce the overall surface area. Calculations are included in APPENDIX A of the Energy Report indicating a cost to replace the structure (M-27) is 239,242 pounds and would save 791 MBTU of oil in heating energy. Infilling the structure (M-25) would cost 3,225 pounds while saving 113 MBTU per year.

3.4.2 Caerwent Building 305

Based on the condition of this building, it has reached the end of its useful life and should be replaced. If it was replaced by a new pre-engineered building the capital cost is estimated at 83,391 pounds. Savings calculated for ECO M-27 in APPENDIX A of the Energy Report are 22460 KWH electricity per year.

3.4.3 Hythe Buildings 2, 3, 4, 5, 6, 30, 31, 32, 33, 34

At this site a large number of very small separate buildings are used for administrative and recreational functions. These are all over 20 years old and their large number results in a maximum surface area (and thus heat loss) per square foot of useable floor space. These spaces should be consolidated. The approach proposed is described under ECO M-25 for Building 29 at this site in APPENDIX A of the Energy Report. It would consist of building a mezzanine above an existing storage area within the large hangar structure, Building 29. The estimated cost for this is 231,040 UK pounds = $339,629 U.S. dollars and savings for heating is estimated at 1,461 MBTU of oil/natural gas per year.

3.5 Summary

As can be seen from the above project lists, there are a variety of approaches to packaging the ECOs studied into construction projects. Depending on this packaging, particular items of work may be accomplished using MILCON funding thru the ECIP program, or may be done using local O&M funding mechanisms. The projects will be grouped under EEAP Increments A, B, or G depending on which mechanism is chosen for funding. Following the Phase II EEAP presentation and receipt of Government comments which should define the funding approach, those projects which are to be ECIP funded will have project documentation prepared.

BURTONWOOD ARMY DEPOT

BUILDINGS TO BE SURVEYED

Bldg. No	Function	Area (SF)
1	General Purpose Warehouse	940,316
2	General Purpose Warehouse	197,000
2	Post HQ Building	88,197
4	Day Room	2,880
4	Bowling Center	3,432
4	Community Center	11,661
10	General Purpose Warehouse	450,464
244	Maintenance Shop	2,005
244	Skill Development Center	2,974
244	Auto Craft Shop	3,269
Family Housing	Survey Representative Sample	

Figure 1.1

CAERWENT ARMY DEPOT ACTIVITY

BUILDINGS TO BE SURVEYED

Bldg. No	Function	Area
6	Motor Pool	10,832
11	Showers/Changing	360
82	Admin. Office	26,957
88	Fire Station	5,600
304	Ammo. Maint.	14,339
305	Break Room	14,339
582	Machine Shop	9,843
923	Welfare Center	22,684
936	BEQ	4,032

Figure 1.2

U.S. ARMY MARINE FLEET ACTIVITY - HYTHE

BUILDINGS TO BE SURVEYED

Bldg. No	Function	Area (SF)
6	Eng Admin.	2,500.
11	Storage	100,000.
14	Ship Rep. Shop	4,680.
29	Offices & Hangar	80,730.

Note: The following buildings were surveyed in addition to the above list agreed to at the Prenegotiation Conference at the request of USAMFA Facilities Engineering.

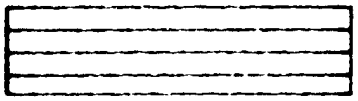
1	Police Station	534
2	Admin. Gen. Purpose	2,160
3	Admin. Gen. Purpose	1,980
4	Toilets	660
5	Post HQ Building	2,500
13	Storage Shed	4,680
15	Storage Shed	3,132
19	Flammable Material Storage	1,440
30	Lunch Room	2,206
31	Cafeteria	1,780
32	Store	228
33	Admin., General Purpose	437
34	Tel. Exchange	340

Figure 1.3

ELECTRICITY

#2 FUEL OIL

#6 FUEL OIL



NATURAL GAS

COAL

LEGEND - ENERGY CONSUMPTION GRAPHS

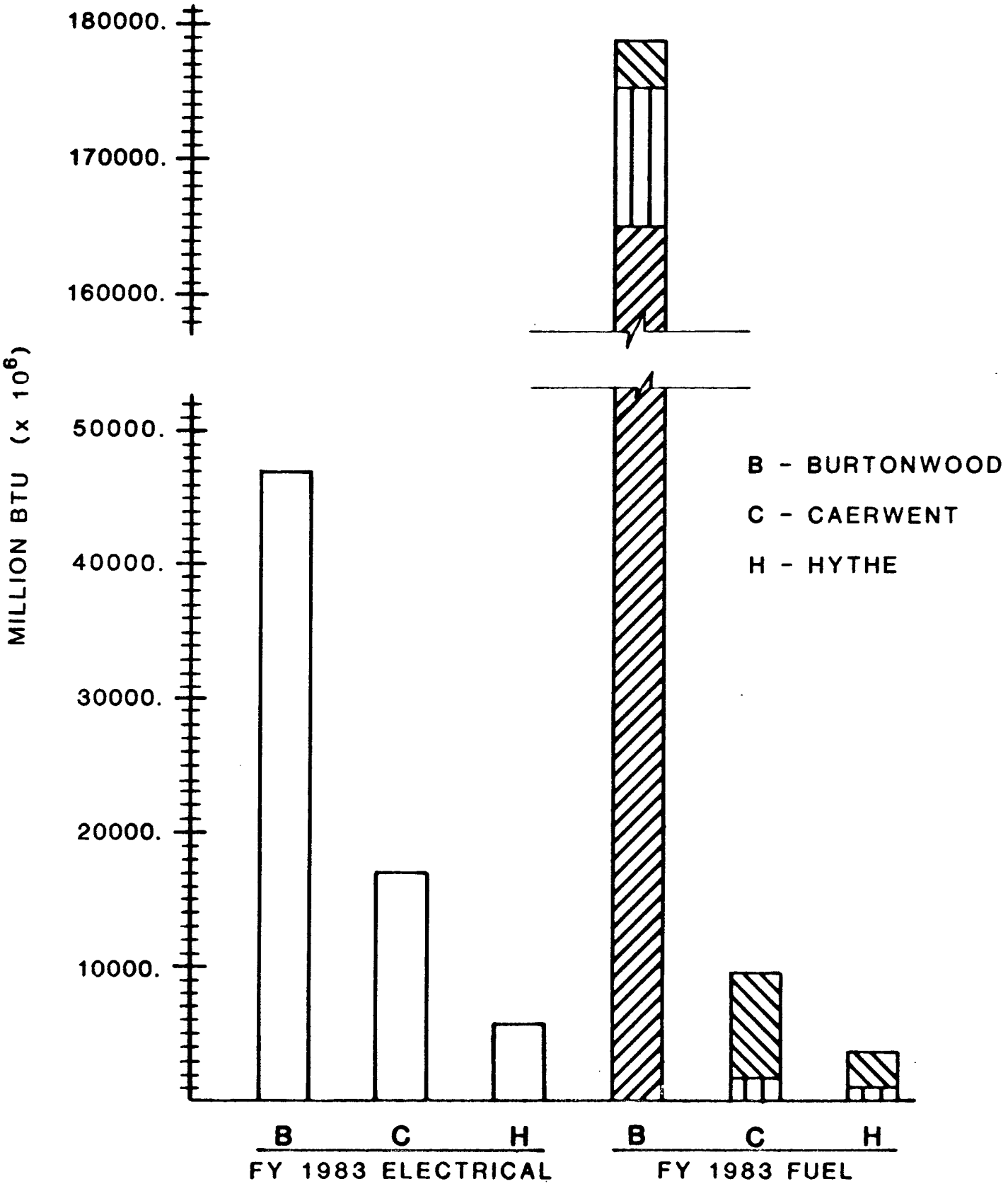
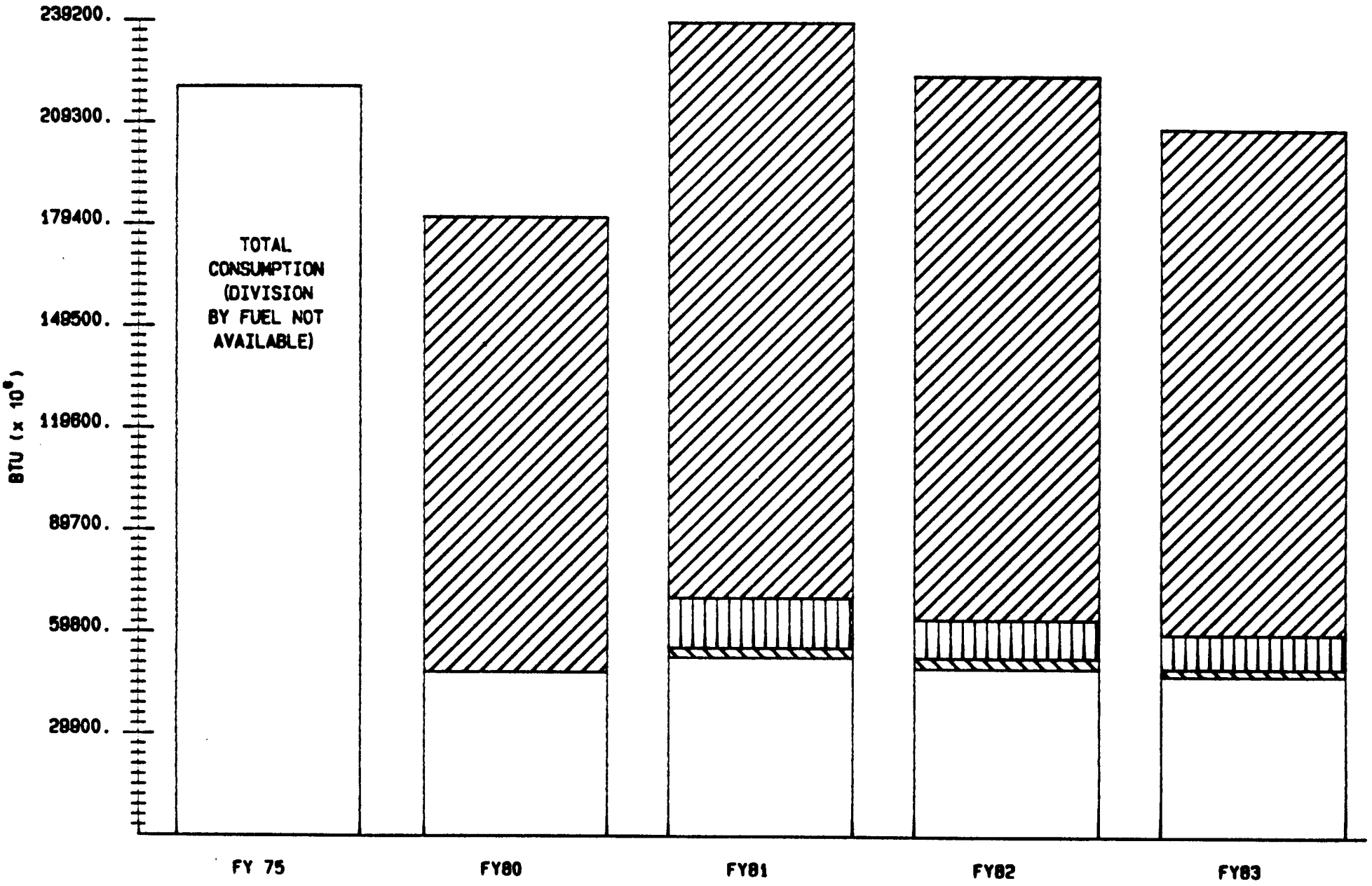
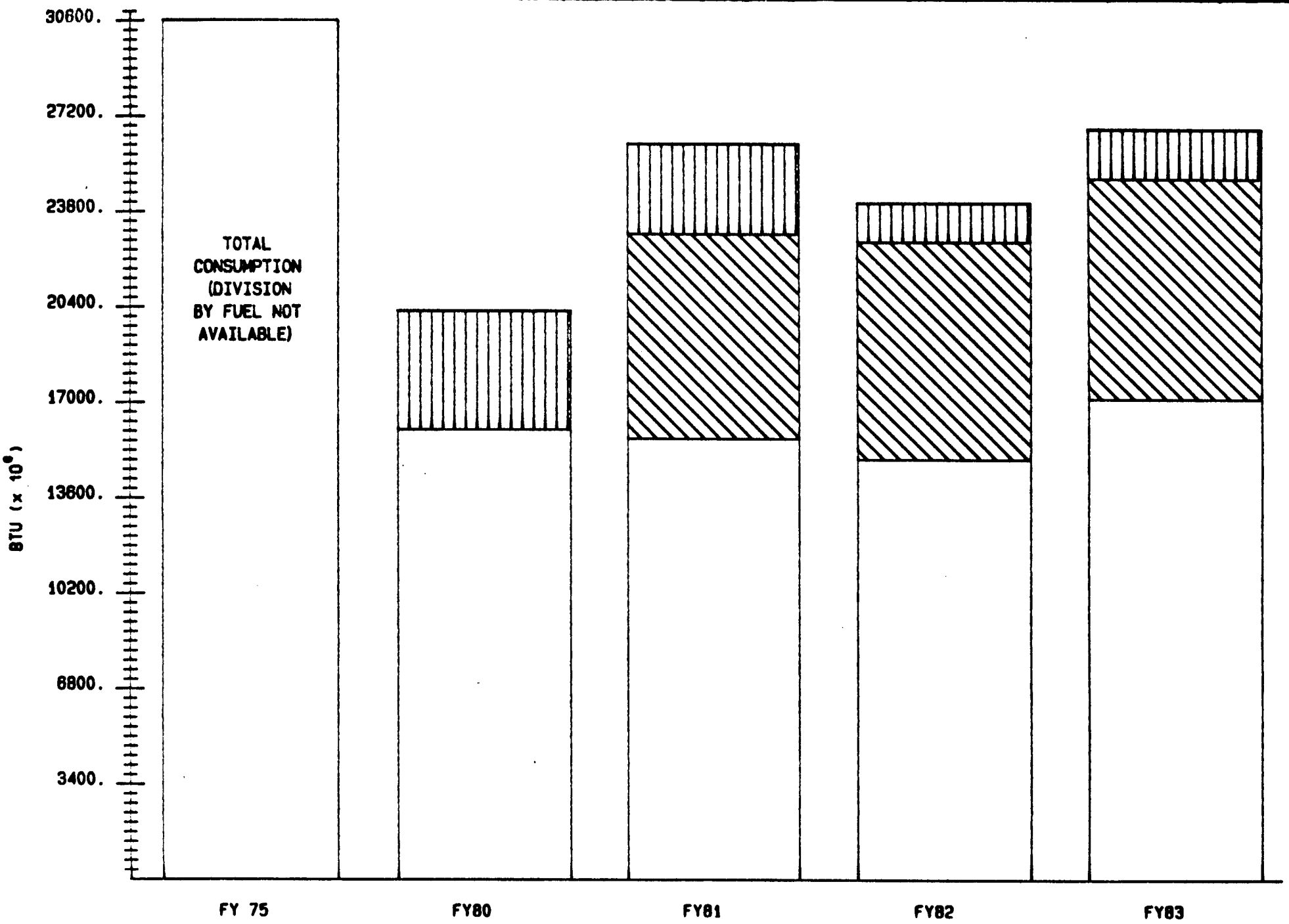

180000.
170000.
160000.
50000.
40000.
30000.
20000.
10000.
MILLION BTU (x 10^6)
B - BURTONWOOD
C - CAERWENT
H - HYTHE
B
C
H
FY 1983 ELECTRICAL
B
C
H
FY 1983 FUEL

FIGURE 2.1



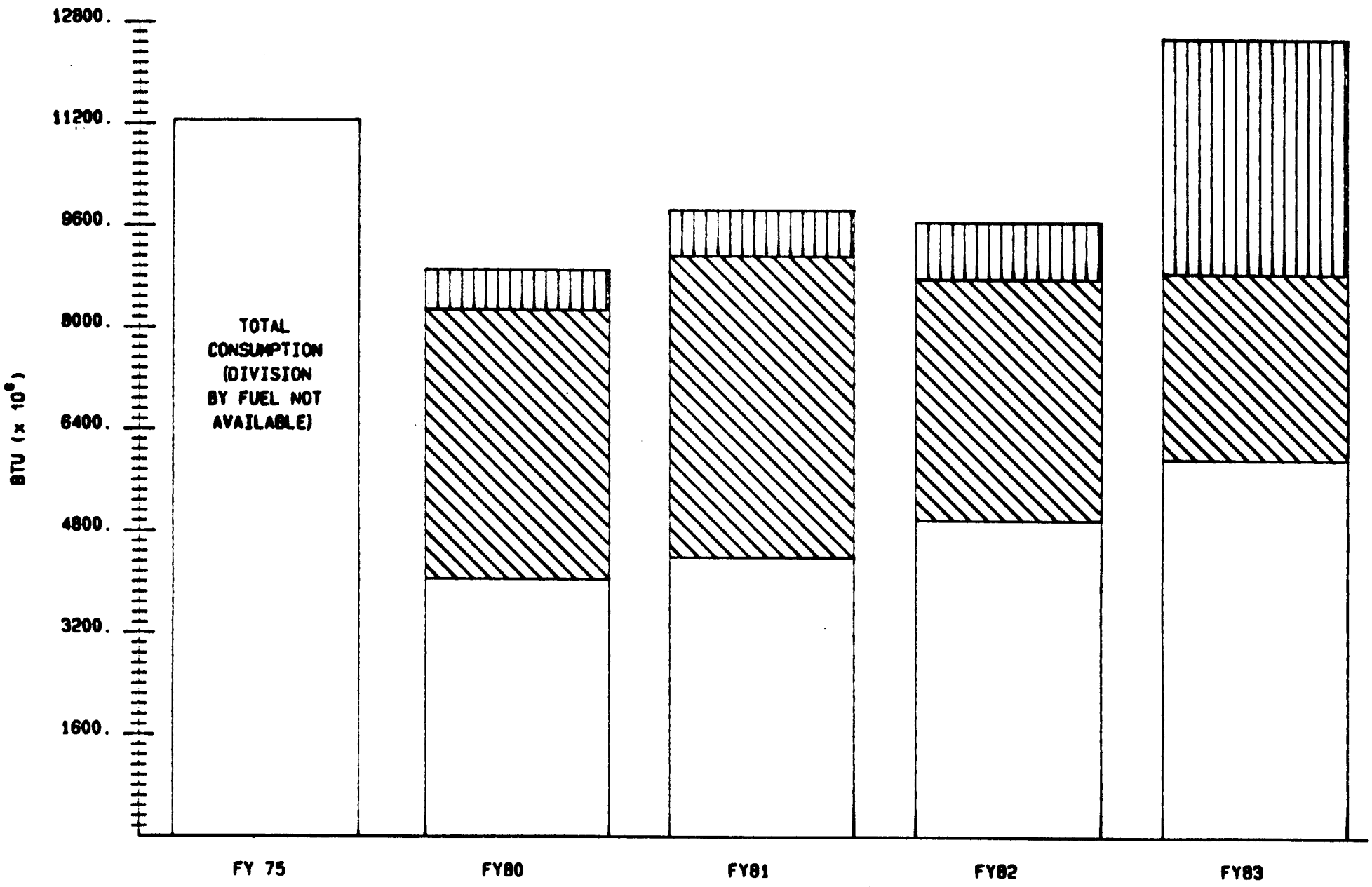
BURTONWOOD SITE ENERGY CONSUMPTION TOTAL

FIGURE 2.2



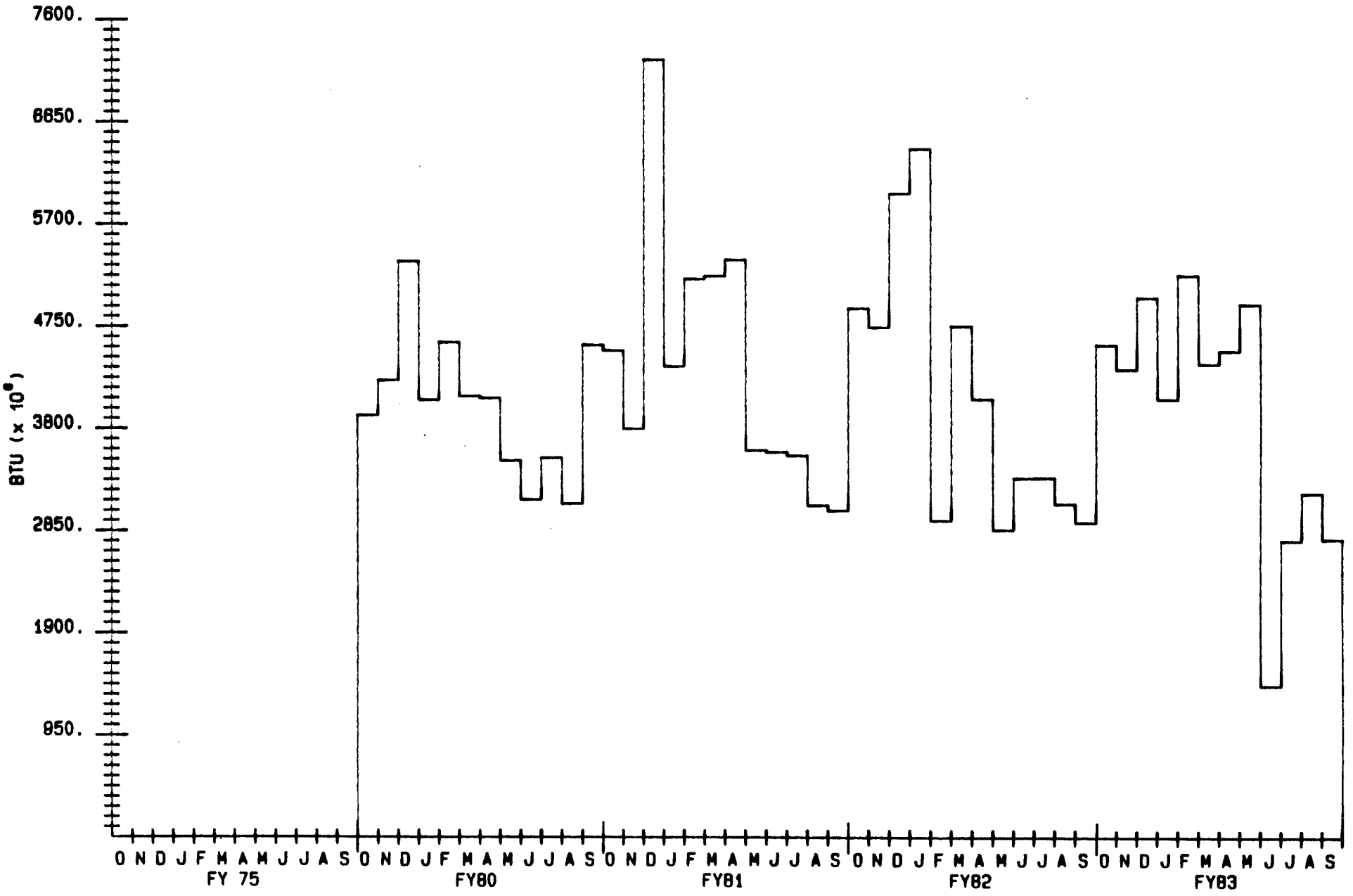
CAERWENT SITE ENERGY CONSUMPTION TOTAL

FIGURE 2.3



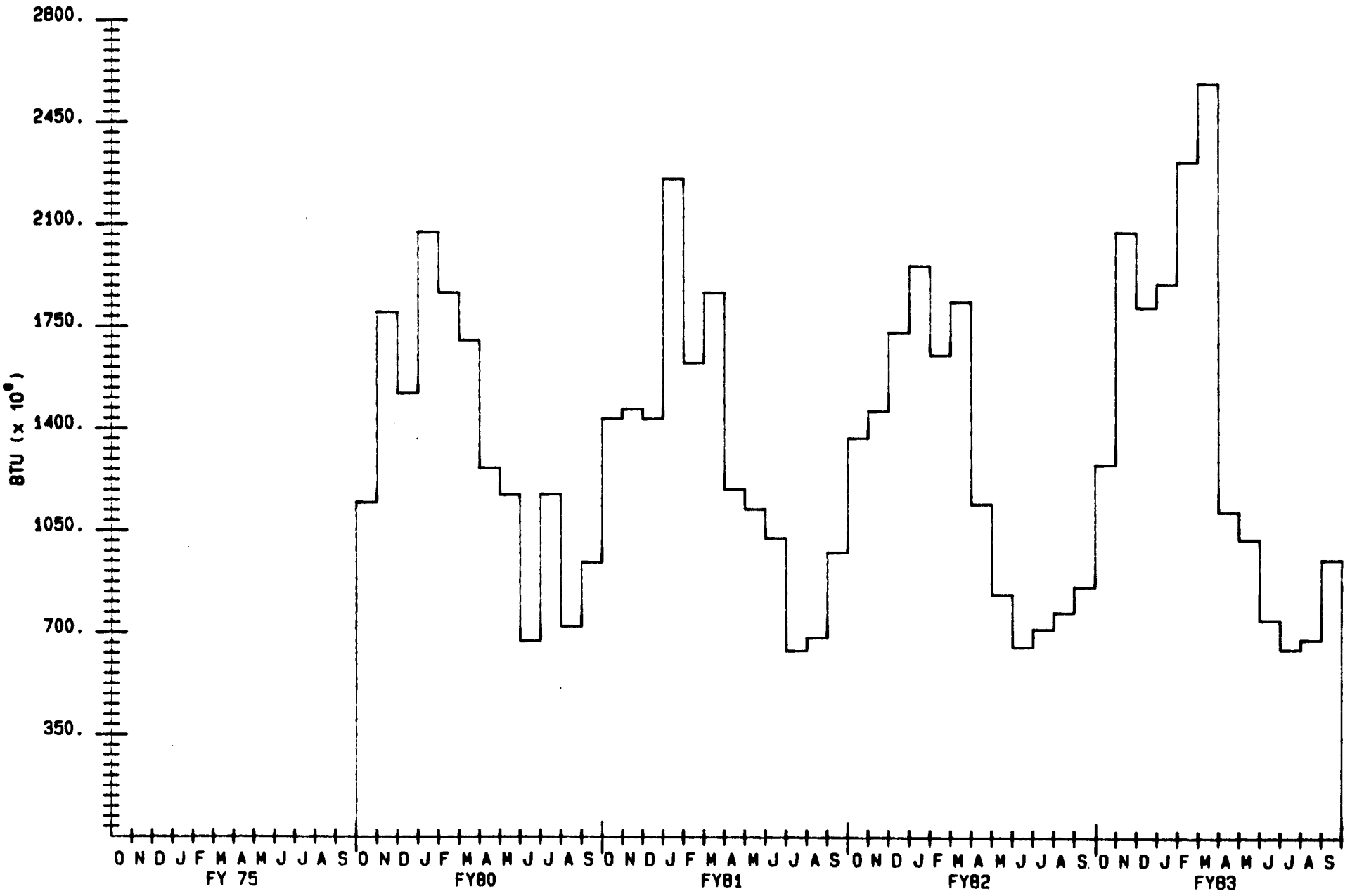
HYTHE SITE ENERGY CONSUMPTION TOTAL

FIGURE 2.4



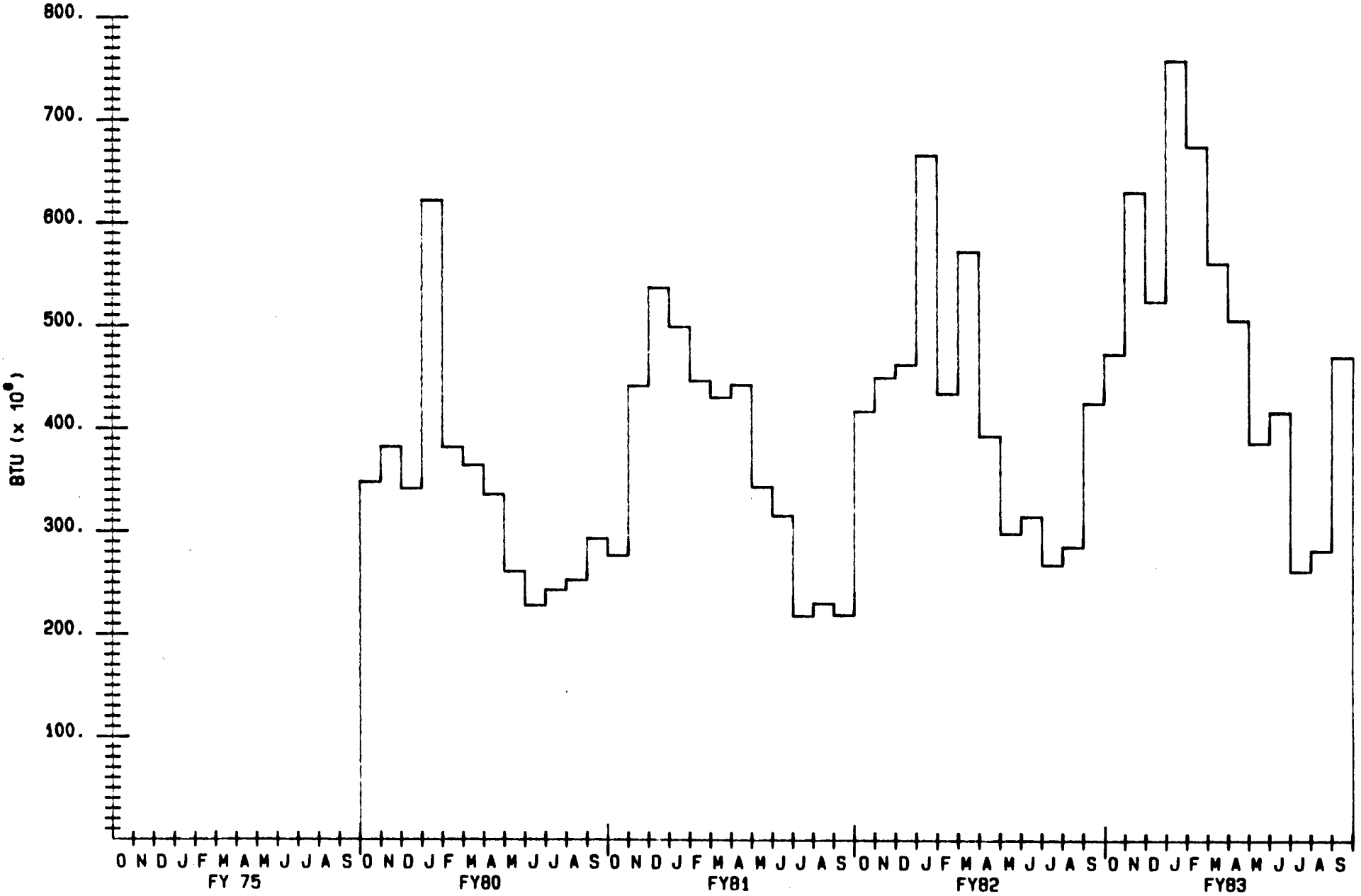
BURTONWOOD SITE (ELECTRICITY).

FIGURE 2.5.



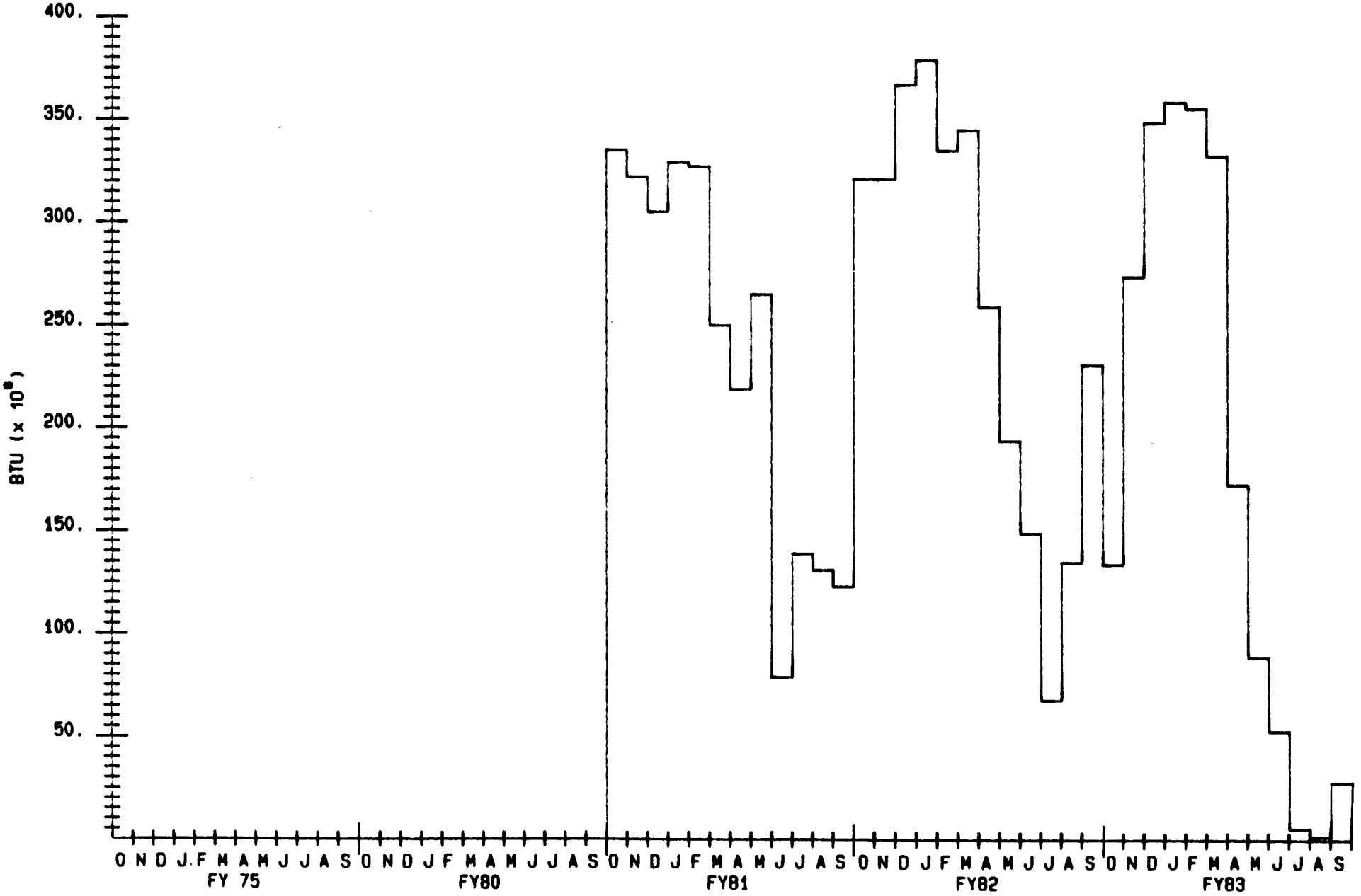
CAERWENT SITE (ELECTRICITY).

FIGURE 2.6.



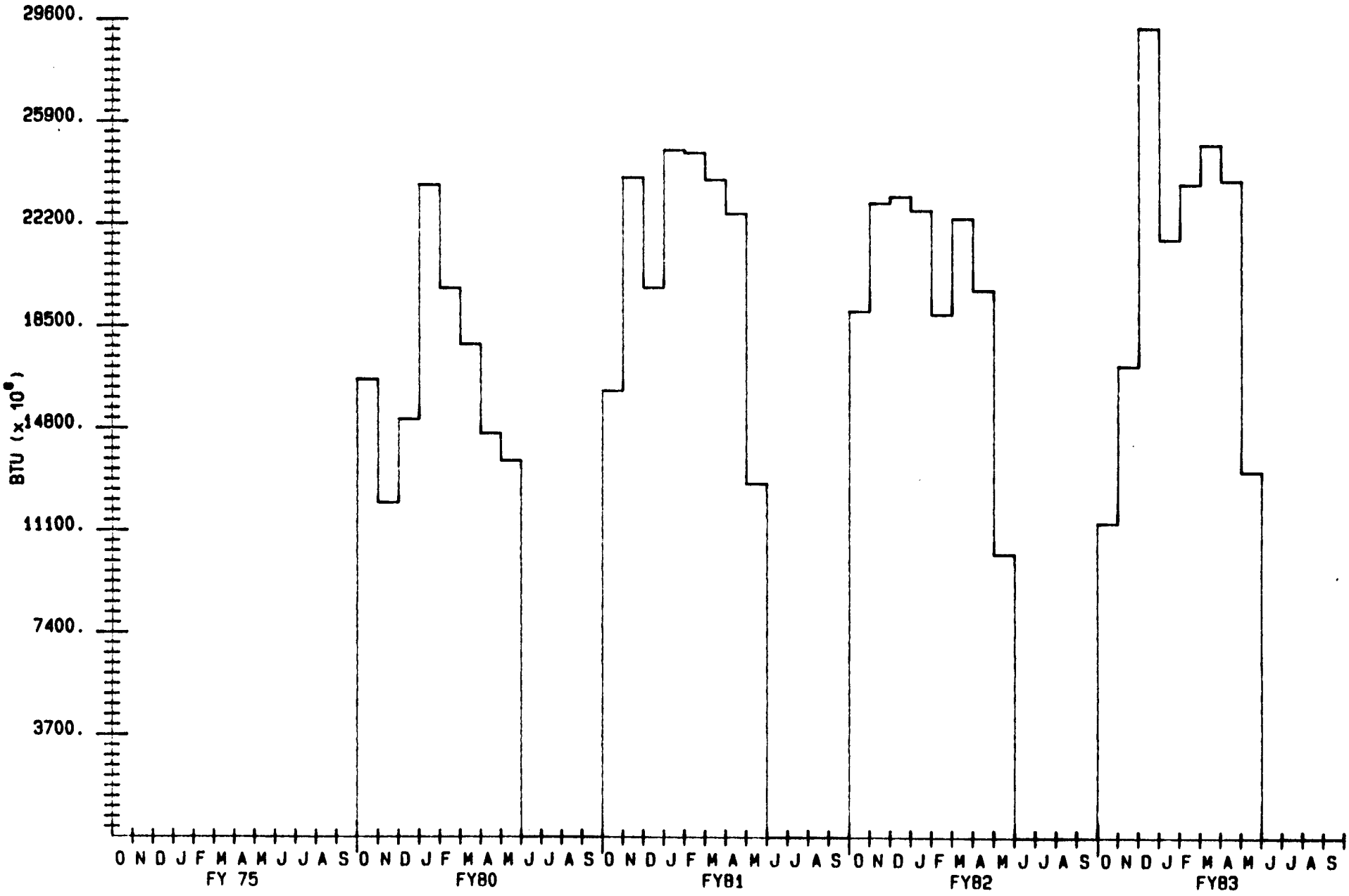
HYTHE SITE (ELECTRICITY).

FIGURE 2.7.



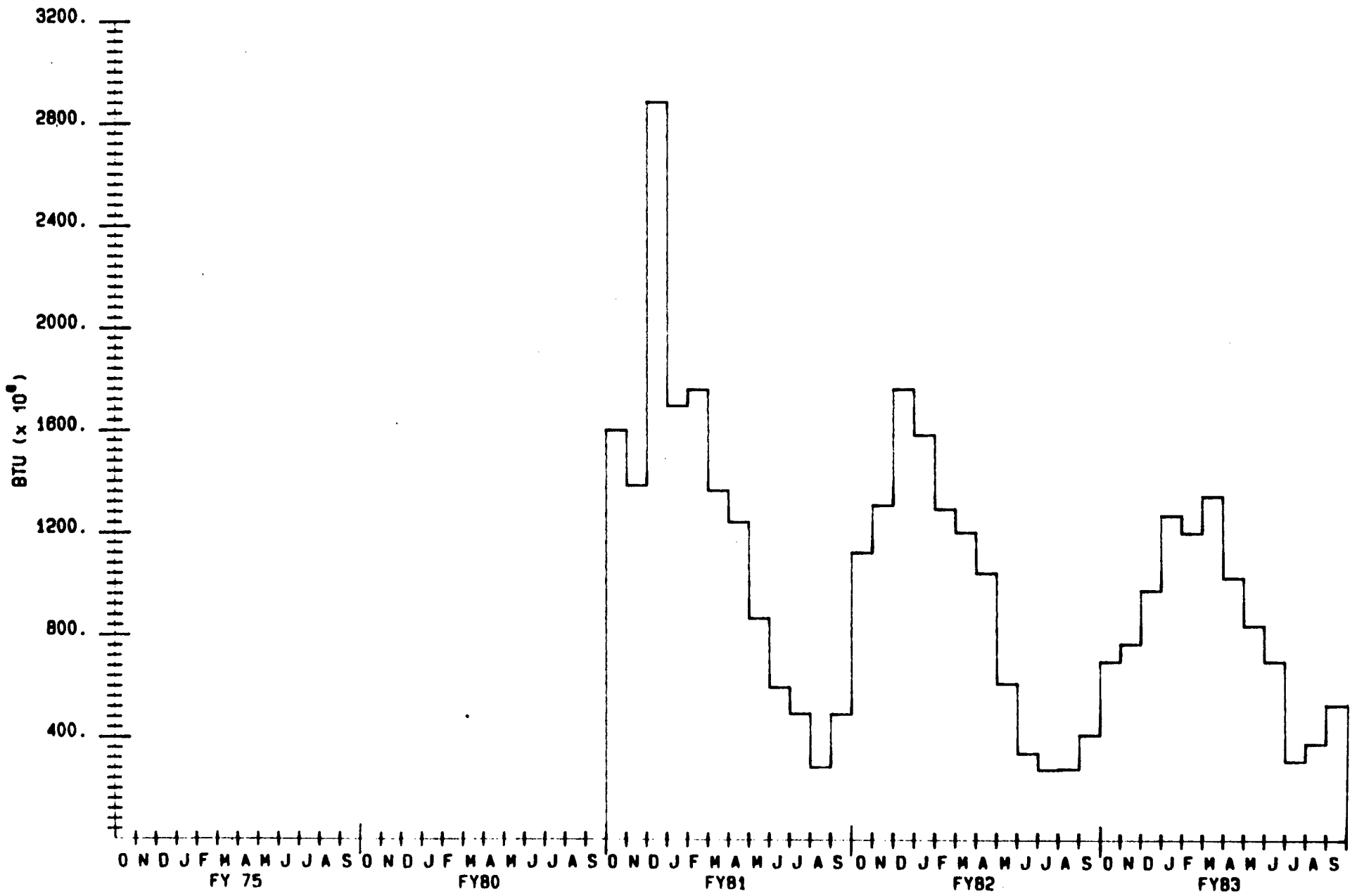
BURTONWOOD SITE (#2 FUEL OIL).

FIGURE 2.8.



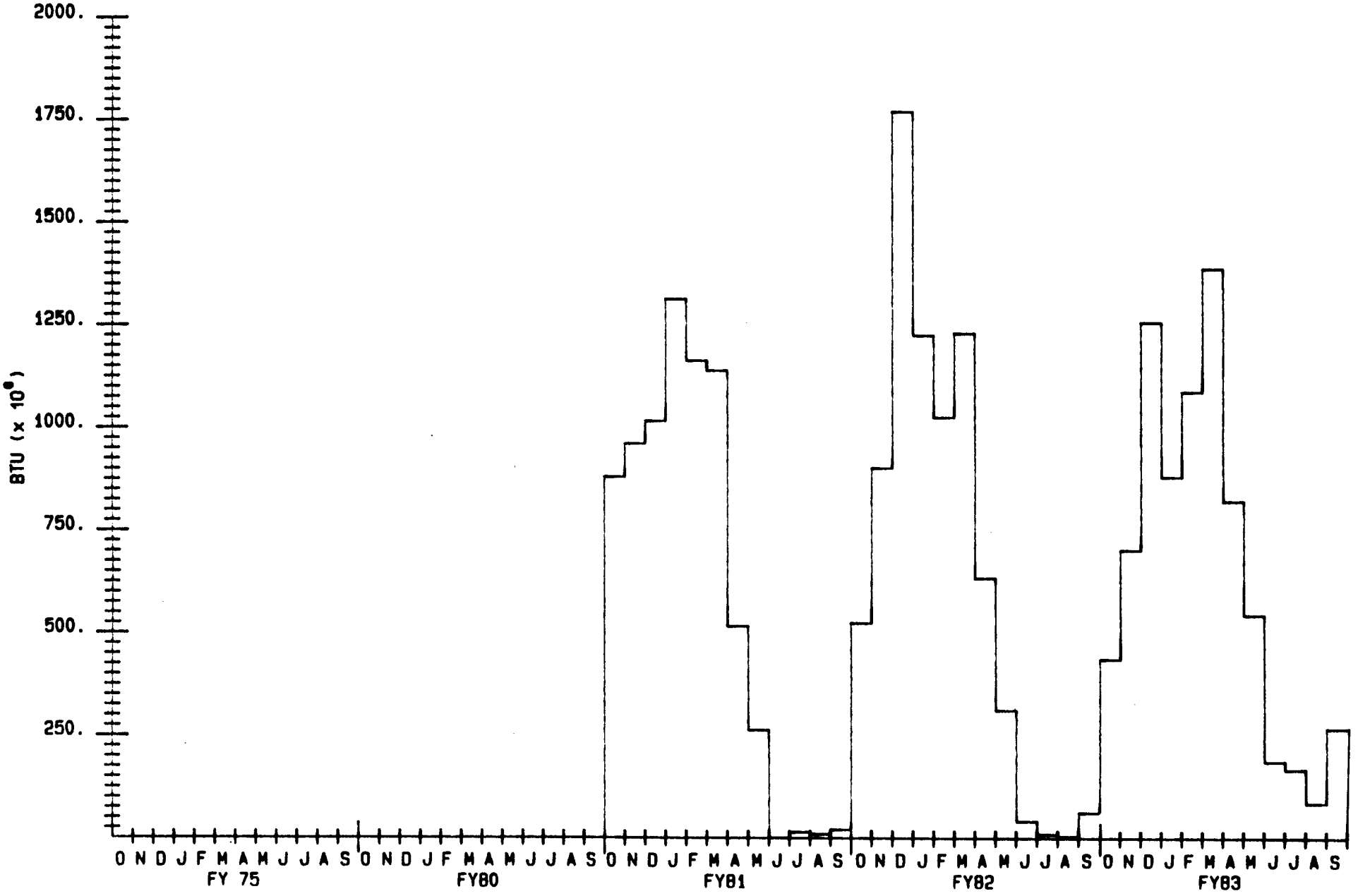
BURTONWOOD SITE (COAL).

FIGURE 2.9.



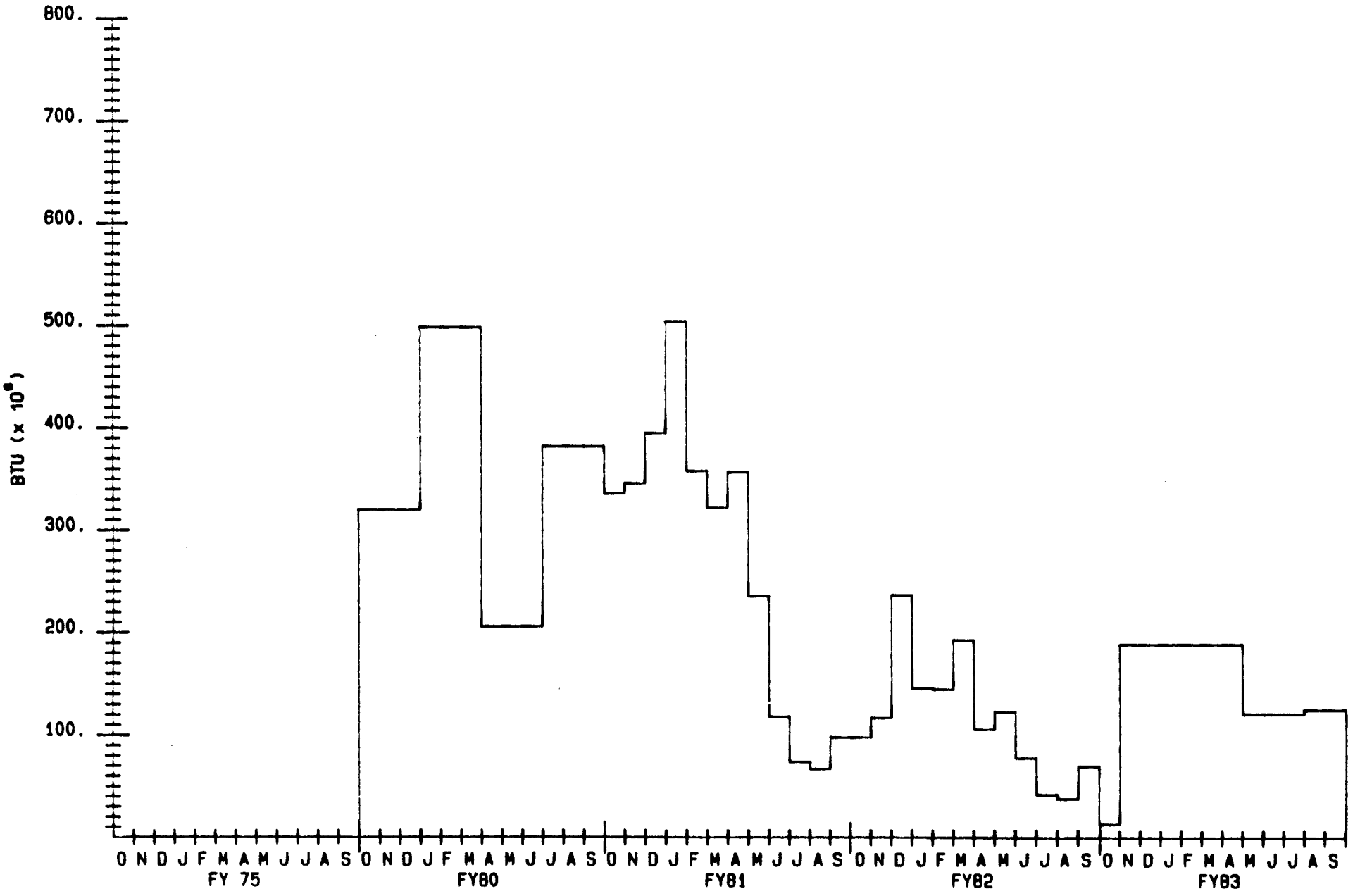
BURTONWOOD SITE (NATURAL GAS).

FIGURE 2.10.



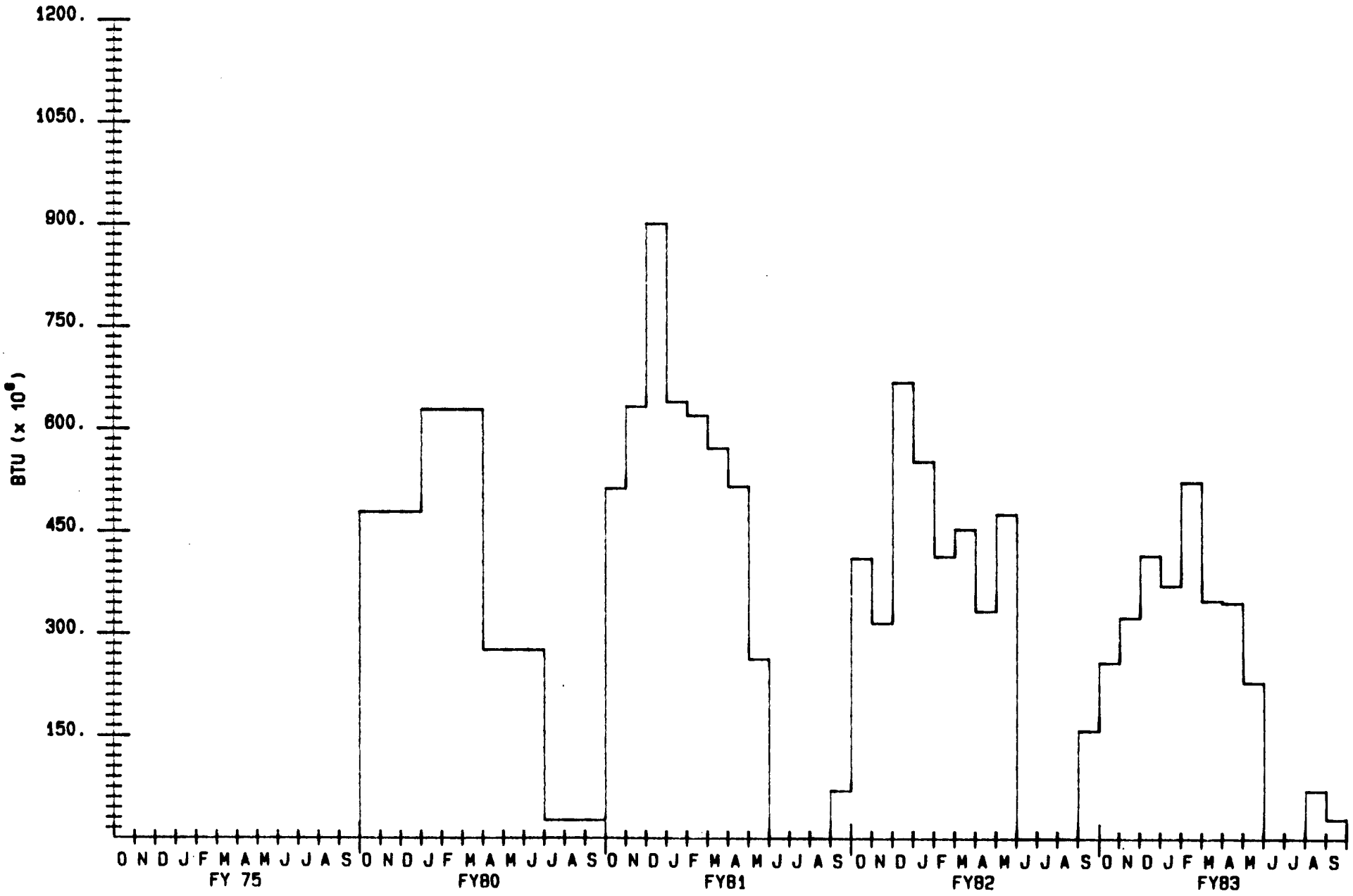
CAERWENT SITE (#2 FUEL OIL).

FIGURE 2.11.



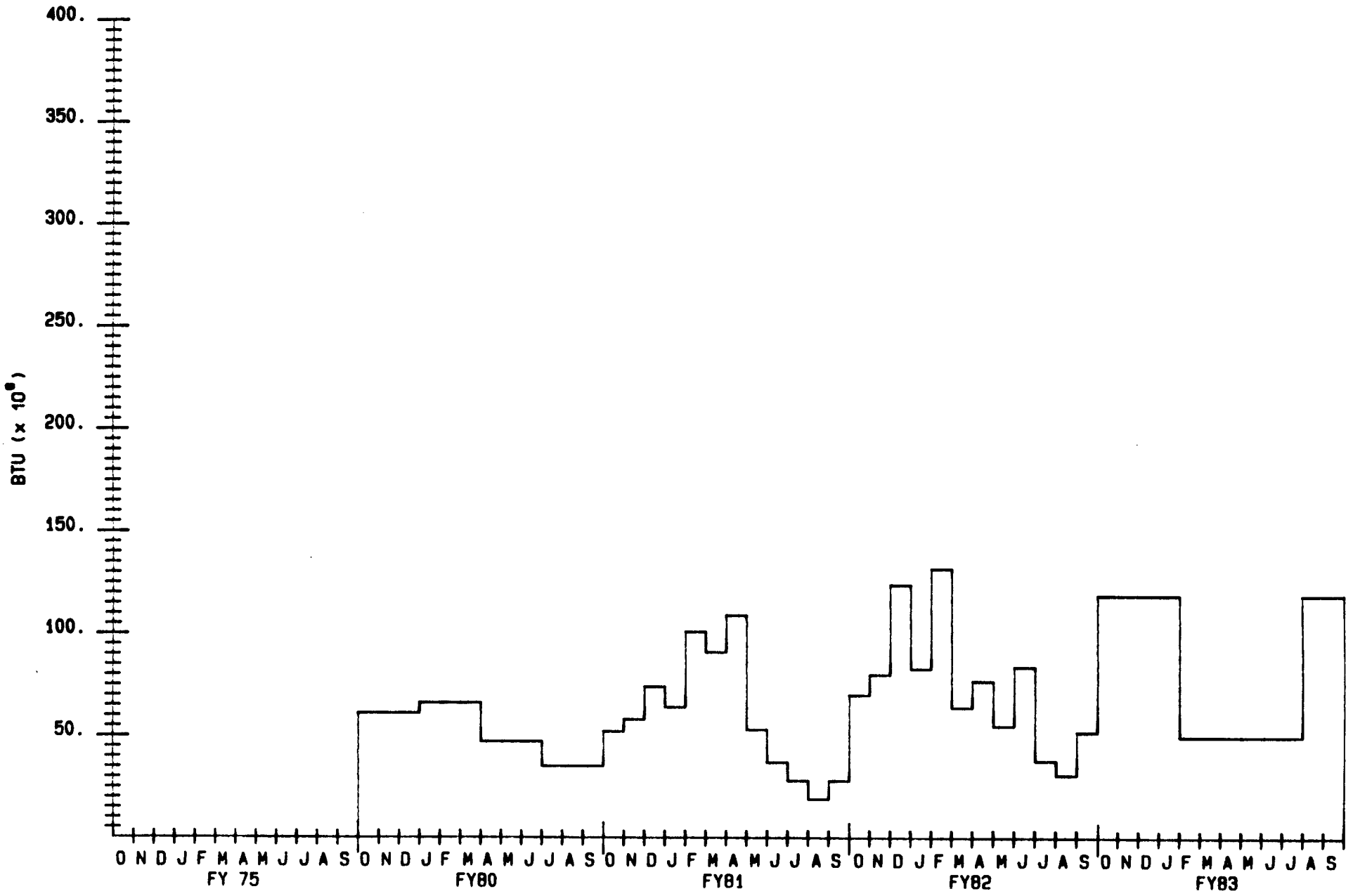
CAERWENT SITE (NATURAL GAS).

FIGURE 2.12.



HYTHE SITE (#2 FUEL OIL),

FIGURE 2.13.



HYTHE SITE (NATURAL GAS).

FIGURE 2.14.

FIGURE 2.15

UTILITY RATES

	BURTONWOOD	CAERWENT	HYTHE
ELECTRICITY	.06382/KWH 5.502/MBTU	.06382/KWH 5.502/MBTU	.06382/KWH 5.502/MBTU
NATURAL GAS	.44/THERM 4.400/MBTU	.49/THERM 4.900/MBTU	.49/THERM 4.900/MBTU
FUEL OIL	.91/GALLON 6.561/MTBU	.91/GALLON 6.561/MBTU	.91/GALLON 6.561/MBTU
COAL	80.42/METRIC TON 2.968/MBTU		

NOTES:

1. All prices in U.S. dollars, October, 1983 which were calculated using an exchange rate of $1.47/UK pound.

2. Energy conversions based on:

Electricity	=	11,600 BTU/KWH
Natural Gas	=	100,000 BTU/THERM
Fuel Oil	=	138,700 BTU/GAL
Coal	=	1.1023 SHORT TONS/METRIC TON AND 24,580,000 BTU/SHORT TON

S/I RATIO RANKED ECIP SUMMARY BURTONWOOD
TABLE 3.1

BUILDING NUMBER	ECO ITEM NO	CONSTRUCTION COST UK POUNDS	CONSTRUCTION COST US DOLLARS	ANNUAL SAVINGS MBTU	ANNUAL SAVINGS DOLLARS	TOT.DISC. SAVINGS	S/I RATIO
4	V-12	1270.	1867.	695.	4560.	51800.	27.65
1	V-12	6646.	9770.	4131.	12261.	188694.	19.25
2	V-17	623.	916.	355.	1054.	16216.	17.64
4	H-68	3065.	4506.	675.	4429.	50310.	11.13
4	V-23	1602.	2355.	234.	1535.	17441.	7.38
2D	V-12	7540.	11084.	1366.	4054.	62395.	5.61
10	V-12	12710.	18684.	2066.	6132.	94370.	5.03
10	H-3B	26950.	39616.	4032.	11967.	184172.	4.63
4	H-20	2971.	4367.	254.	1666.	18931.	4.32
1	H-3B	56900.	83643.	7829.	23236.	357609.	4.26
2	W-6	3962.	5824.	541.	1606.	24712.	4.23
10	H-3A	36380.	53479.	4312.	12798.	196961.	3.67
1	H-3A	72760.	106957.	8432.	25026.	385153.	3.59
1	H-62	192400.	282828.	19664.	58363.	898203.	3.16
10	V-26	1146.	1685.	107.	318.	4887.	2.89
1	V-26	1146.	1685.	107.	318.	4887.	2.89
FHSG	H-8	11358.	16696.	681.	2996.	38354.	2.29
4	V-8	1000.	1470.	45.	295.	3354.	2.27
SIT3	L-20	708.	1041.	39.	214.	2355.	2.25
244	H-69	13475.	19808.	738.	4058.	44681.	2.25
244	H-8	12776.	18781.	646.	3553.	39118.	2.08
10	L-19	16970.	24946.	721.	3967.	43680.	1.74
1	L-19	12728.	18710.	481.	2645.	29123.	1.55
10	L-5	6367.	9359.	185.	1015.	11180.	1.19
1	V-23	807.	1186.	31.	92.	1416.	1.19
1	L-5	13573.	19952.	358.	1970.	21694.	1.08
2D	V-26	19488.	28647.	644.	1911.	29416.	1.02
1	H-7B	2157792.	3171954.	70600.	209541.	3224832.	1.01
10	H-8	139863.	205599.	3915.	11620.	178827.	0.87
1	H-8	229154.	336856.	5928.	17594.	270776.	0.80
1	H-7A	2952768.	4340568.	70600.	209541.	3224832.	0.74
2D	H-8	53575.	78755.	1248.	3704.	57006.	0.72
1	V-27	113769.	167240.	2400.	7123.	109626.	0.65
1	L-17	57252.	84160.	729.	4010.	44147.	0.52
10	V-27	73950.	108706.	1190.	3532.	54356.	0.50
2D	V-27	96703.	142153.	1556.	4618.	71074.	0.50
4	H-8	37986.	55839.	352.	2309.	26236.	0.47
2H	H-7B	212928.	313004.	2894.	8589.	132191.	0.42
244	H-7	16884.	24819.	146.	804.	8853.	0.36
2H	H-8	18845.	27702.	167.	496.	7628.	0.27
10	H-7B	1146141.	1684827.	9531.	28288.	435352.	0.26

S/I RATIO RANKED ECIP SUMMARY BURTONWOOD
TABLE 3.1

BUILDING NUMBER	ECO ITEM NO	CONSTRUCTION COST UK POUNDS	US DOLLARS	ANNUAL SAVINGS MBTU	DOLLARS	TOT.DISC. SAVINGS	S/I RATIO
2D	H-7B	390370.	573844.	3228.	9581.	147447.	0.26
244	H-9B	9301.	13672.	51.	281.	3088.	0.23
4	H-7	54674.	80371.	227.	1489.	16919.	0.21
4	H-9B	22885.	33641.	85.	558.	6335.	0.19
244	H-9A	7916.	11637.	34.	187.	2059.	0.18
10	H-7A	1622694.	2385360.	9531.	28288.	435352.	0.18
2D	H-7A	552682.	812442.	3228.	9581.	147447.	0.18
1	M-23	918700.	1350489.	3703.	20376.	224342.	0.17
4	H-9A	19478.	28633.	56.	367.	4174.	0.15
2H	H-7A	315779.	464195.	1379.	4093.	62989.	0.14
2H	H-5	47483.	69800.	164.	487.	7491.	0.11
10	H-5	7814.	11487.	26.	77.	1188.	0.10
2H	H-9D	89115.	130999.	298.	884.	13612.	0.10
2H	H-9C	133673.	196499.	448.	1330.	20464.	0.10
2H	H-9B	75849.	111498.	197.	585.	8998.	0.08
2H	H-9A	113774.	167248.	296.	879.	13521.	0.08

S/I RATIO RANKED ECIP SUMMARY CAERWENT
TABLE 3.2

BUILDING NUMBER	ECO ITEM NO	CONSTRUCTION COST UK POUNDS	US DOLLARS	ANNUAL SAVINGS MBTU	DOLLARS	TOT.DISC. SAVINGS	S/I RATIO
305	V-12	729.	1072.	679.	3735.	41124.	38.24
582	V-23	1457.	2142.	683.	4481.	50906.	23.69
936	H-8	793.	1166.	276.	1352.	17311.	14.80
88	H-8	613.	901.	178.	1168.	13267.	14.67
6	V-17	2580.	3793.	695.	4560.	51800.	13.61
88	V-23	807.	1186.	183.	1201.	13640.	11.46
305	H-8	867.	1274.	171.	940.	10346.	8.09
6	H-5	2122.	3119.	323.	2119.	24074.	7.69
582	H-8	2559.	3762.	334.	2191.	24894.	6.59
971	H-8	983.	1445.	128.	840.	9540.	6.58
936	H-8	983.	1445.	128.	840.	9540.	6.58
6	H-8	1688.	2481.	215.	1411.	16025.	6.44
82	H-8	2779.	4085.	290.	1903.	21615.	5.27
11	H-5	1248.	1835.	112.	735.	8348.	4.53
82	V-23	1207.	1774.	91.	597.	6782.	3.81
11	H-8	602.	885.	38.	249.	2832.	3.19
6	V-23	2430.	3572.	152.	997.	11329.	3.16
304	H-8	2060.	3028.	151.	740.	9471.	3.12
82	H-33	5175.	7607.	262.	1719.	19528.	2.56
88	H-9B	5018.	7376.	215.	1411.	16025.	2.16
936	H-9B	12827.	18856.	551.	2700.	34559.	1.83
88	H-9A	4271.	6278.	142.	932.	10584.	1.68
936	H-7	2402.	3531.	76.	499.	5665.	1.60
936	H-9A	10917.	16048.	364.	1784.	22830.	1.42
11	V-23	1999.	2939.	46.	302.	3429.	1.16
6	H-9C	14232.	20921.	317.	2080.	23627.	1.13
6	V-27	10000.	14700.	205.	1345.	15279.	1.04
305	H-9B	8803.	12940.	214.	1178.	12971.	1.00
6	H-9A	12114.	17808.	209.	1371.	15577.	0.87
582	H-7	5807.	8536.	98.	643.	7304.	0.85
971	H-9B	25156.	36979.	405.	2657.	30186.	0.81
936	H-9B	25156.	36979.	405.	2657.	30186.	0.81
582	H-9B	7723.	11353.	124.	814.	9242.	0.81
304	H-7	48113.	70726.	891.	4366.	55884.	0.79
305	H-9A	7493.	11015.	141.	778.	8566.	0.77
88	H-7	4123.	6061.	61.	400.	4547.	0.75
6	H-9D	27730.	40763.	413.	2710.	30782.	0.75
582	V-27	9377.	13784.	130.	853.	9689.	0.70
304	H-9B	11788.	17328.	190.	931.	11917.	0.69
971	H-9A	21410.	31473.	267.	1752.	19900.	0.63
936	H-9A	21410.	31473.	267.	1752.	19900.	0.63

S/I RATIO RANKED ECIP SUMMARY CAERWENT
TABLE 3.2

BUILDING NUMBER	ECO ITEM NO	CONSTRUCTION COST UK POUNDS	CONSTRUCTION COST US DOLLARS	ANNUAL SAVINGS MBTU	ANNUAL SAVINGS DOLLARS	TOT.DISC. SAVINGS	S/I RATIO
582	H-9A	6572.	9661.	82.	538.	6112.	0.63
82	H-9	15041.	22110.	188.	1233.	14012.	0.63
6	H-9B	23602.	34695.	273.	1791.	20347.	0.58
304	H-9A	10033.	14749.	125.	612.	7840.	0.53
11	H-9B	7938.	11669.	64.	420.	4770.	0.41
936	H-7	14999.	22049.	108.	529.	6774.	0.31
11	H-9A	6756.	9931.	42.	276.	3130.	0.31
304	V-27	9244.	13589.	56.	274.	3512.	0.26
305	H-7	17367.	25529.	88.	486.	5355.	0.21
971	H-7	24402.	35871.	76.	499.	5665.	0.16
11	H-7	2879.	4232.	7.	46.	522.	0.12
6	H-7	22834.	33566.	51.	335.	3801.	0.11

S/I RATIO RANKED ECIP SUMMARY HYTHE
TABLE 3.3

BUILDING NUMBER	ECO ITEM NO	CONSTRUCTION COST UK POUNDS	US DOLLARS	ANNUAL SAVINGS MBTU	DOLLARS	TOT.DISC. SAVINGS	S/I RATIO
6	V-23	467.	686.	64.	420.	4770.	6.92
5	V-23	467.	686.	64.	420.	4770.	6.92
33	H-5	109.	160.	17.	83.	1066.	6.63
30	H-5	408.	600.	62.	304.	3889.	6.46
SITE	L-17	7788.	11448.	1054.	5801.	63864.	5.56
5	H-8	1329.	1954.	137.	899.	10211.	5.21
2	H-8	1399.	2057.	135.	886.	10062.	4.88
6	H-8	1311.	1927.	126.	827.	9391.	4.86
1	H-7	475.	698.	36.	236.	2683.	3.83
34	H-36	477.	701.	29.	142.	1819.	2.58
33	H-36	477.	701.	29.	142.	1819.	2.58
32	H-36	477.	701.	29.	142.	1819.	2.58
31	H-36	477.	701.	29.	142.	1819.	2.58
30	H-36	477.	701.	29.	142.	1819.	2.58
30	V-23	1115.	1639.	64.	314.	4014.	2.44
14	H-5	394.	579.	17.	112.	1267.	2.18
13	H-5	95.	140.	4.	26.	298.	2.13
29	H-8	24293.	35711.	1008.	6613.	75129.	2.10
15	V-23	3737.	5493.	128.	840.	9540.	1.73
31	V-23	1602.	2355.	64.	314.	4014.	1.70
1	H-9B	2855.	4197.	96.	630.	7155.	1.70
14	H-66	458.	673.	13.	85.	969.	1.43
1	H-9A	2430.	3572.	63.	413.	4696.	1.31
29	H-7	20154.	29626.	510.	3346.	38012.	1.28
6	H-7	764.	1123.	14.	92.	1043.	0.93
5	H-7	764.	1123.	14.	92.	1043.	0.93
2	H-7	619.	910.	11.	72.	820.	0.90
4	H-9B	2185.	3212.	28.	184.	2087.	0.65
15	H-9B	6878.	10111.	87.	571.	6484.	0.64
3	H-9B	6013.	8839.	76.	499.	5665.	0.64
2	H-9B	4802.	7059.	61.	400.	4547.	0.64
29	H-9B	6143.	9030.	77.	505.	5739.	0.63
6	H-9B	9798.	14403.	123.	807.	9168.	0.63
33	H-9B	281.	413.	4.	20.	251.	0.61
34	H-9B	714.	1050.	9.	44.	564.	0.54
32	H-9B	238.	350.	3.	15.	188.	0.54
30	H-9B	722.	1061.	9.	44.	564.	0.53
31	H-9B	649.	954.	8.	39.	502.	0.52
6	H-9A	8340.	12260.	82.	538.	6112.	0.50
29	H-9A	5228.	7685.	51.	335.	3801.	0.49
15	H-9A	5854.	8605.	57.	374.	4248.	0.49

S/I RATIO RANKED ECIP SUMMARY HYTHE
TABLE 3.3

BUILDING NUMBER	ECO ITEM NO	CONSTRUCTION COST UK POUNDS	CONSTRUCTION COST US DOLLARS	ANNUAL SAVINGS MBTU	ANNUAL SAVINGS DOLLARS	TOT.DISC. SAVINGS	S/I RATIO
4	H-9A	1859.	2733.	18.	118.	1342.	0.49
3	H-9A	5118.	7523.	50.	328.	3727.	0.49
2	H-9A	4087.	6008.	40.	262.	2981.	0.49
34	H-9A	608.	894.	6.	29.	376.	0.42
32	H-9A	203.	298.	2.	10.	125.	0.42
30	H-9A	615.	904.	6.	29.	376.	0.41
31	H-9A	552.	811.	5.	24.	314.	0.39
15	V-27	4981.	7322.	38.	249.	2832.	0.39
5	H-9B	9307.	13681.	68.	446.	5068.	0.37
33	H-9A	239.	351.	2.	10.	125.	0.36
5	H-9A	8100.	11907.	45.	295.	3354.	0.28
14	H-8	10063.	14793.	38.	249.	2832.	0.19
13	H-8	7379.	10847.	28.	184.	2087.	0.19
30	H-7	1715.	2521.	7.	34.	439.	0.17
34	H-7	1167.	1715.	4.	20.	251.	0.15
31	H-5	553.	813.	2.	10.	125.	0.15
31	H-7	4539.	6672.	15.	73.	941.	0.14
4	H-7	2509.	3688.	7.	46.	522.	0.14
33	H-7	1293.	1901.	4.	20.	251.	0.13
3	H-7	3474.	5107.	9.	59.	671.	0.13
32	H-7	724.	1064.	2.	10.	125.	0.12
14	V-27	4981.	7322.	12.	79.	894.	0.12
13	V-27	9962.	14644.	23.	151.	1714.	0.12
14	H-7	8810.	12951.	11.	72.	820.	0.06
13	H-7	5600.	8232.	7.	46.	522.	0.06

EEAP PROJECT SUMMARY BURTONWOOD
TABLE 3.4

BUILDING NUMBER	ECO ITEM NO	ECO DESCRIPTION	CONSTRUCTION COST	ELEC.KWH SAVINGS	FUEL MBTU SAVINGS	
1	H-7B	ROOF INSUL(SPRAY ON)	3171954.	0.	70600.	COAL
	TOTALS FOR PROJECT NO 1		3171954.	0.	70600.	COAL
					0.	OIL
					0.	GAS
1	V-12	WEATHERSTRIPPING	9770.	0.	4131.	COAL
2D	V-12	WEATHERSTRIPPING	11084.	0.	1366.	COAL
10	V-12	WEATHERSTRIPPING	18684.	0.	2066.	COAL
10	V-26	PVC THERMAL CURTAINS AT L	1685.	0.	107.	COAL
1	V-26	PVC THERMAL CURTAINS AT L	1685.	0.	107.	COAL
1	V-23	VESTIBULES	1186.	0.	31.	COAL
2D	V-26	PVC THERMAL CURTAINS AT L	28647.	0.	644.	COAL
	TOTALS FOR PROJECT NO 2		72741.	0.	8452.	COAL
					0.	OIL
					0.	GAS
244	H-8	WALL INSULATION	18781.	55669.	0.	ELEC
244	H-69	CONVERT ELEC TO GAS HTG	19808.	63585.	0.	ELEC
	TOTALS FOR PROJECT NO 3		38589.	119254.	0.	COAL
					0.	OIL
					0.	GAS
4	V-12	WEATHERSTRIPPING	1867.	0.	695.	OIL
4	H-68	REZONE HEATING SYS	4506.	0.	675.	OIL
4	V-23	VESTIBULES	2355.	0.	234.	OIL
4	H-20	INSULATE STEAM LINES	4367.	0.	254.	OIL
4	V-8	REPLACE FIREPLACE DAMPERS	1470.	0.	45.	OIL
	TOTALS FOR PROJECT NO 4		14565.	0.	0.	COAL
					1903.	OIL
					0.	GAS
1	H-62	CENT.SUPERV.CONTROL	282828.	0.	19664.	COAL
	TOTALS FOR PROJECT NO 5		282828.	0.	19664.	COAL
					0.	OIL
					0.	GAS
2	W-6	INSULAT HW PIPE,STORE TNK	5824.	0.	541.	COAL
2	V-17	AUTO VENTILATION CONTROL	916.	0.	355.	COAL
	TOTALS FOR PROJECT NO 6		6740.	0.	896.	COAL
					0.	OIL
					0.	GAS
FHSG	H-8	WALL INSULATION	16696.	0.	681.	GAS

EEAP PROJECT SUMMARY BURTONWOOD
TABLE 3.4

BUILDING NUMBER	ECO ITEM NO	ECO DESCRIPTION	CONSTRUCTION COST	ELEC.KWH SAVINGS	FUEL MBTU SAVINGS	
TOTALS FOR PROJECT NO 7			16696.	0.	0.	COAL
					0.	OIL
					681.	GAS
10	H-3B	SETBACK CONTROLS(TSTAT OV	39616.	0.	4032.	COAL
1	H-3B	SETBACK CONTROLS(TSTAT OV	83643.	0.	7829.	COAL
TOTALS FOR PROJECT NO 8			123259.	0.	11861.	COAL
					0.	OIL
					0.	GAS
SIT3	L-20	MORE EFF.OUTDOOR SEC.LTG.	1041.	3351.	0.	ELEC
10	L-19	ADD WALKWAY LIGHTING	24946.	62161.	0.	ELEC
1	L-19	ADD WALKWAY LIGHTING	18710.	41445.	0.	ELEC
10	L-5	USE HIGH EFF.LAMPS,FIXTUR	9359.	15910.	0.	ELEC
1	L-5	USE HIGH EFF.LAMPS,FIXTUR	19952.	30873.	0.	ELEC
TOTALS FOR PROJECT NO 9			74008.	153740.	0.	COAL
					0.	OIL
					0.	GAS
10	H-3A	SETBACK CONTROLS(ZN VLVS)	53479.	0.	4312.	COAL
1	H-3A	SETBACK CONTROLS(ZN VLVS)	106957.	0.	8432.	COAL
TOTALS FOR PROJECT NO 10			160436.	0.	12744.	COAL
					0.	OIL
					0.	GAS

EEAP PROJECT SUMMARY CAERWENT
TABLE 3.5

BUILDING NUMBER	ECO ITEM NO	ECO DESCRIPTION	CONSTRUCTION COST	ELEC.KWH SAVINGS	FUEL MBTU SAVINGS	
936	H-7	ROOF INSULATION	3531.	0.	76.	OIL
	TOTALS FOR PROJECT NO 1		3531.	0.	0.	COAL
					76.	OIL
					0.	GAS
936	H-8	WALL INSULATION	1166.	0.	276.	GAS
88	H-8	WALL INSULATION	901.	0.	178.	OIL
6	H-5	OPAQUE PNL IN UNUSED WIND	3119.	0.	323.	OIL
582	H-8	WALL INSULATION	3762.	0.	334.	OIL
971	H-8	WALL INSULATION	1445.	0.	128.	OIL
936	H-8	WALL INSULATION	1445.	0.	128.	OIL
6	H-8	WALL INSULATION	2481.	0.	215.	OIL
82	H-8	WALL INSULATION	4085.	0.	290.	OIL
11	H-5	OPAQUE PNL IN UNUSED WIND	1835.	0.	112.	OIL
11	H-8	WALL INSULATION	885.	0.	38.	OIL
304	H-8	WALL INSULATION	3028.	0.	151.	GAS
	TOTALS FOR PROJECT NO 2		24152.	0.	0.	COAL
					1746.	OIL
					427.	GAS
88	H-9A	DOUBLE GLAZING	6278.	0.	142.	OIL
936	H-9A	DOUBLE GLAZING	16048.	0.	364.	GAS
	TOTALS FOR PROJECT NO 3		22326.	0.	0.	COAL
					142.	OIL
					364.	GAS
88	H-9B	DOUBLE GLAZING(K UNITS)	7376.	0.	215.	OIL
936	H-9B	DOUBLE GLAZING(K UNITS)	18856.	0.	551.	GAS
6	H-9C	DOUBLE GLAZING(K U,NO CLE	20921.	0.	317.	OIL
	TOTALS FOR PROJECT NO 4		47153.	0.	0.	COAL
					532.	OIL
					551.	GAS
6	V-27	REPLACE LOADING DOORS	14700.	0.	205.	OIL
	TOTALS FOR PROJECT NO 5		14700.	0.	0.	COAL
					205.	OIL
					0.	GAS
82	H-33	THERMOSTATIC RADIATOR VAL	7607.	0.	262.	OIL
	TOTALS FOR PROJECT NO 6		7607.	0.	0.	COAL
					262.	OIL
					0.	GAS
6	V-17	AUTO VENTILATION CONTROL	3793.	0.	695.	OIL

EEAP PROJECT SUMMARY CAERWENT
TABLE 3.5

BUILDING NUMBER	ECO ITEM NO	ECO DESCRIPTION	CONSTRUCTION COST	ELEC.KWH SAVINGS	FUEL MBTU SAVINGS	
TOTALS FOR PROJECT NO 7			3793.	0.	0.	COAL
					695.	OIL
					0.	GAS
582	V-23	VESTIBULES	2142.	0.	683.	OIL
88	V-23	VESTIBULES	1186.	0.	183.	OIL
82	V-23	VESTIBULES	1774.	0.	91.	OIL
6	V-23	VESTIBULES	3572.	0.	152.	OIL
11	V-23	VESTIBULES	2939.	0.	46.	OIL
TOTALS FOR PROJECT NO 8			11613.	0.	0.	COAL
					1155.	OIL
					0.	GAS
305	V-12	WEATHERSTRIPPING	1072.	58523.	0.	ELEC
305	H-8	WALL INSULATION	1274.	14724.	0.	ELEC
305	H-9B	DOUBLE GLAZING(K UNITS)	12940.	18459.	0.	ELEC
TOTALS FOR PROJECT NO 9			15286.	91706.	0.	COAL
					0.	OIL
					0.	GAS

EEAP PROJECT SUMMARY HYTHE
TABLE 3.6

BUILDING NUMBER	ECO ITEM NO	ECO DESCRIPTION	CONSTRUCTION COST	ELEC.KWH SAVINGS	FUEL MBTU SAVINGS	
33	H-5	OPAQUE PNL IN UNUSED WIND	160.	0.	17.	GAS
30	H-5	OPAQUE PNL IN UNUSED WIND	600.	0.	62.	GAS
5	H-8	WALL INSULATION	1954.	0.	137.	OIL
2	H-8	WALL INSULATION	2057.	0.	135.	OIL
6	H-8	WALL INSULATION	1927.	0.	126.	OIL
14	H-5	OPAQUE PNL IN UNUSED WIND	579.	0.	17.	OIL
13	H-5	OPAQUE PNL IN UNUSED WIND	140.	0.	4.	OIL
29	H-8	WALL INSULATION	35711.	0.	1008.	OIL
14	H-66	BLOCK UP UNUSED DOORS	673.	0.	13.	OIL
	TOTALS FOR PROJECT NO 1		43801.	0.	0.	COAL
					1440.	OIL
					79.	GAS
1	H-7	ROOF INSULATION	698.	0.	36.	OIL
29	H-7	ROOF INSULATION	29626.	0.	510.	OIL
	TOTALS FOR PROJECT NO 2		30324.	0.	0.	COAL
					546.	OIL
					0.	GAS
SITE	L-17	MORE EFF.OUTDOOR LTG.	11448.	90885.	0.	ELEC
	TOTALS FOR PROJECT NO 3		11448.	90885.	0.	COAL
					0.	OIL
					0.	GAS
34	H-36	ADD ZONE CONTROLS	701.	0.	29.	GAS
33	H-36	ADD ZONE CONTROLS	701.	0.	29.	GAS
32	H-36	ADD ZONE CONTROLS	701.	0.	29.	GAS
31	H-36	ADD ZONE CONTROLS	701.	0.	29.	GAS
30	H-36	ADD ZONE CONTROLS	701.	0.	29.	GAS
	TOTALS FOR PROJECT NO 4		3505.	0.	0.	COAL
					0.	OIL
					145.	GAS
1	H-9A	DOUBLE GLAZING	3572.	0.	63.	OIL
	TOTALS FOR PROJECT NO 5		3572.	0.	0.	COAL
					63.	OIL
					0.	GAS
1	H-9B	DOUBLE GLAZING(K UNITS)	4197.	0.	96.	OIL
	TOTALS FOR PROJECT NO 6		4197.	0.	0.	COAL
					96.	OIL
					0.	GAS
6	V-23	VESTIBULES	686.	0.	64.	OIL

EEAP PROJECT SUMMARY HYTHE
TABLE 3.6

BUILDING NUMBER	ECO ITEM NO	ECO DESCRIPTION	CONSTRUCTION COST	ELEC.KWH SAVINGS	FUEL MBTU SAVINGS	
5	V-23	VESTIBULES	686.	0.	64.	OIL
30	V-23	VESTIBULES	1639.	0.	64.	GAS
15	V-23	VESTIBULES	5493.	0.	128.	OIL
31	V-23	VESTIBULES	2355.	0.	64.	GAS
TOTALS FOR PROJECT NO 7			10859.	0.	0.	COAL
					256.	OIL
					128.	GAS